INSTRUCTION MANUAL

FOR THE

NM-30A RFI METER

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STODDART NO. 40317

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INSTRUCTION MANUAL FOR THE NM-30A POWER SUPPLY

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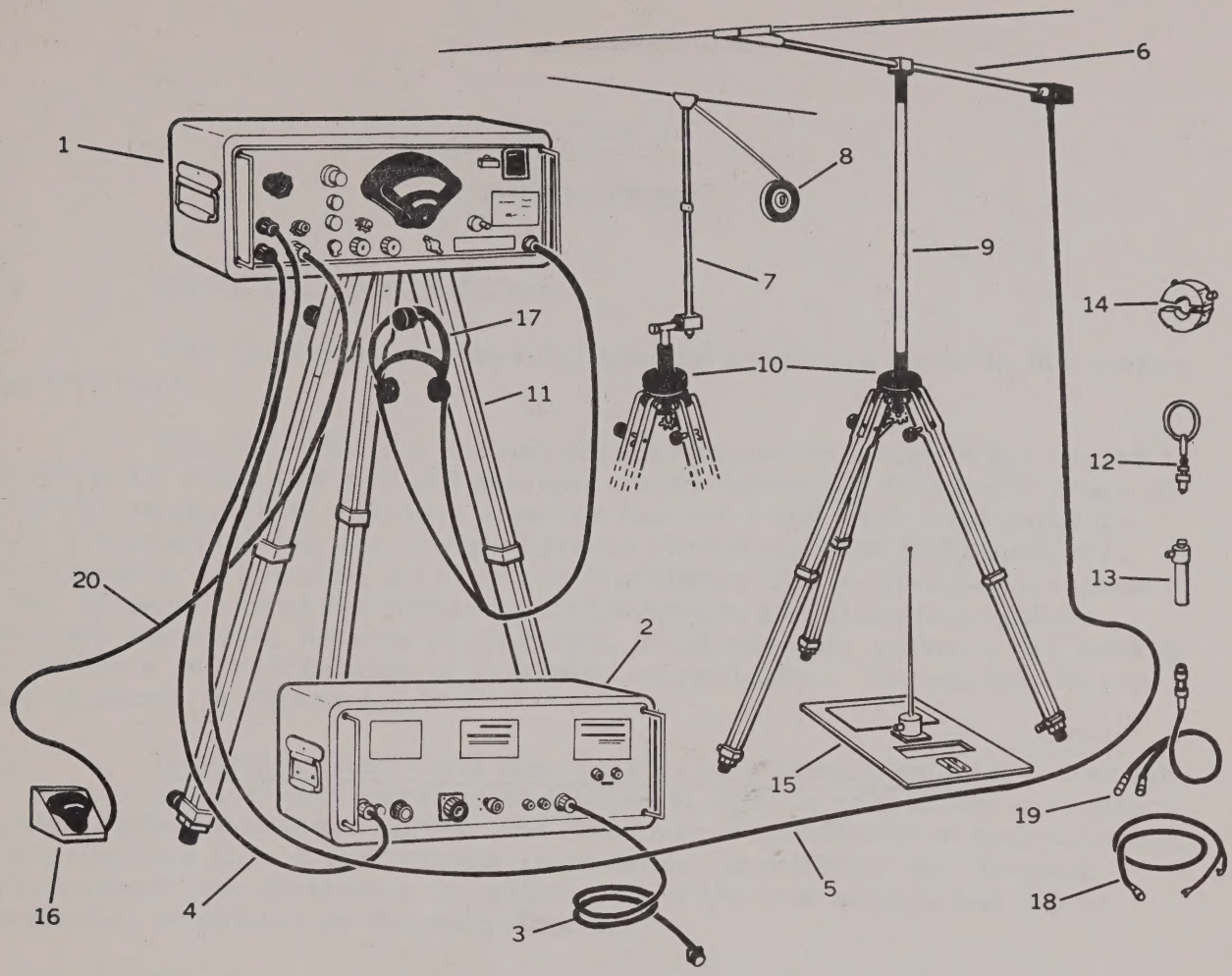


NM-30A EQUIPMENT AND ACCESSORIES

Item	Stoddart Number	Description
1	NM-30A	Radio Interference-Field Intensity Meter, Frequency Range — 20 mc to 400 mc
2	91923-2	AC Power Supply
3	91258-1	AC Power Cable, 6 ft.
4	91487-1	Power Supply Cable, 10 ft.
5	90933-1	RF Transmission Line, 20 ft.
6	91865-2	Dipole Antenna, Low Frequency (20-88 mc)
7	91870-2	Dipole Antenna, High Frequency (88-400 mc)
8	10645	Frequency Measuring Tape
9	90920-2	Antenna Mast
10	91932-2	Antenna Mounting Adapter
11	91933-2	Collapsible Tripod (see note 1)
12	90799-2	Loop Antenna
13	90995-2	Loop Antenna Base
14	91550-1	RF Current Probe
15	91972-4	Ground Plane Vertical Antenna (Antenna element will be required if not ordering Item #6)
16	90078-11	Remote Meter
17	10796	Headphones, 300-7000 cps response
18	90071-1	Oscilloscope Cable, 3 ft.
19	90757-2	RF Probe Cable, 18 inches
20	90075-2	Remote Meter Cable, 20 ft.
*21	90074-1	Headphone Extension Cable, 20 ft.
*22	91595-6	Meter Transit Case
*23	91595-4	Power Supply Transit Case
*24	92049-1	Tripod Bag (Holds one Tripod)
*25	91971-2	Antenna Bag
*26	91981-2	Cable Bag
*27	————	Instruction Book
*28	91934-2	Tripod Bag (Holds two tripods)

NOTES: 1. Item (11) may be used to support either the NM-30A or antennas.
** Items not shown.*

SECTION I

OPERATION

1.0 GENERAL DESCRIPTION

The electrical and physical specifications are given in the preceding brochure.

The NM-30A is a special purpose receiver designed for use as a selective RF voltmater or field strength meter within the frequency range of 20 to 400 megacycles. Various detector functions and calibrated input devices are provided for use in signal (radio interference or field intensity) measurement or location, as required in military or commercial acceptance tests. It may be used for frequency conservation and allocation studies, spectrum signature, antenna propagation, field intensity surveys, RF energy surveillance and verification of systems compatibility. The equipment supplied is shown in Figure 1-1.

1.1 Laboratory and Field Site Interference Measurements. - For laboratory and production control measurements, screen rooms are used where freedom from extraneous signals and maximum repeatibility in measurement of interference from a test sample is desired. In military interference measurement specifications, the placement of the test sample and dipole antenna are stipulated by the specification.

Interference surveys and open site measurements of radiated interference are performed using the dipole or vertical antennas. For military interference open site testing, the antenna-to-test sample distance is controlled. Interference surveys to locate sources of man-made interference are usually performed with the dipole antenna.

1.2 Antenna Pattern and Field Strength Measurements. - Measurement of field strength and antenna patterns are made using the RFI Meter and the tuned dipole antenna. To conduct field strength measurements or surveys properly, the operator must consider site selection, VHF propagation, antenna placement and orientation, RFI operation, and ground conditions.

1.3 Laboratory Uses. - The NM-30A Radio Interference Field Intensity Meter is also a selective highly sensitive RF voltmeter. Some of the uses are as follows.

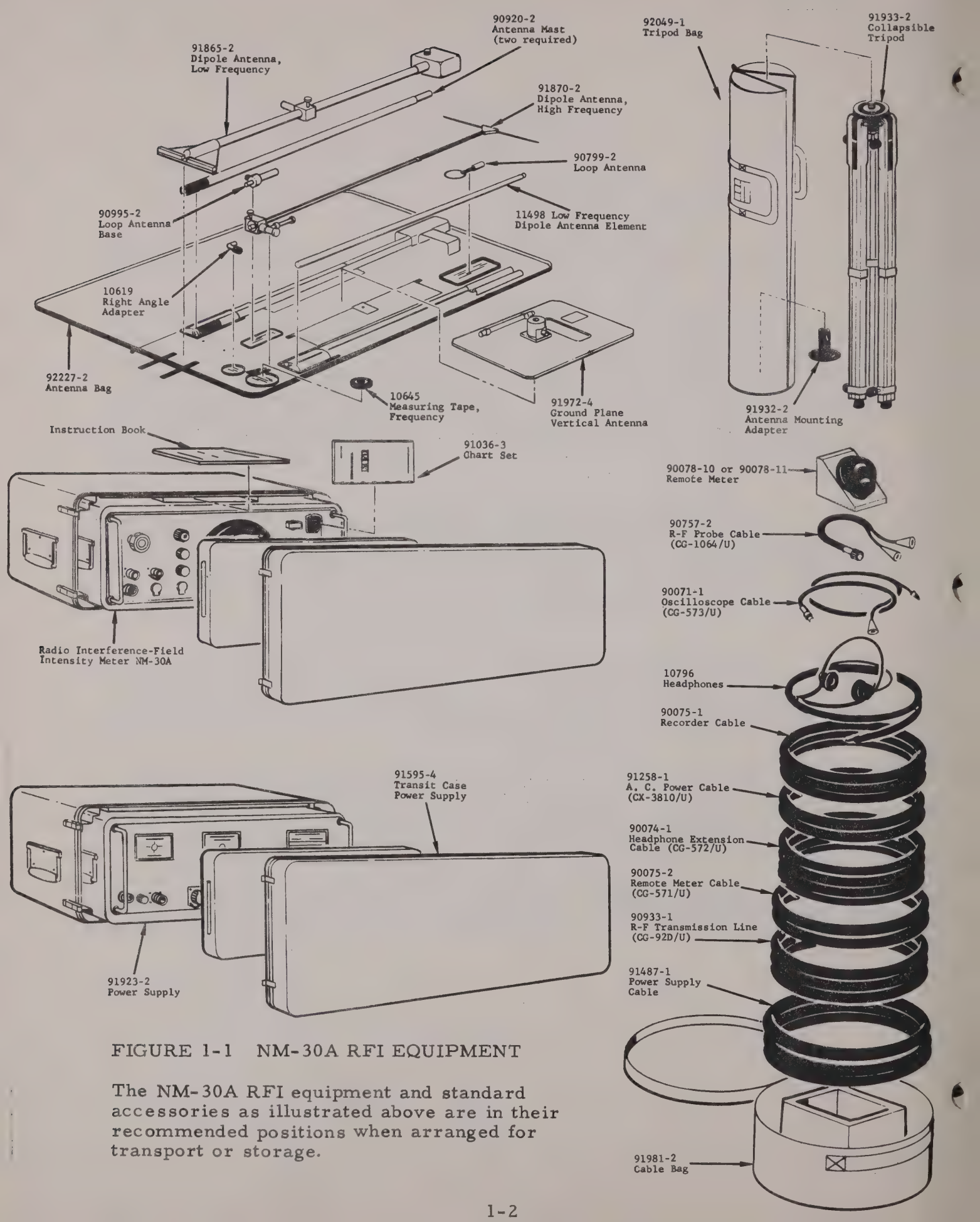


FIGURE 1-1 NM-30A RFI EQUIPMENT

The NM-30A RFI equipment and standard accessories as illustrated above are in their recommended positions when arranged for transport or storage.

It can be used as a null indicator in conjunction with RF bridges suitable for operation in the 20 to 400 megacycle band.

It can be used to determine amplifier stage gain by measuring the signal output to input ratio.

It can be used to check the RF voltage, up to 1 volt, of any transmission line. The NM-30A will substitute for the load if the line impedance is 50 ohms.

It can be used to determine insertion loss of coaxial lines, filters, etcetera.

Controlled measurements of radiated interference are usually performed in a screen room using the tuned dipole antenna. See Figure 1-2. The typical test shown is representative of those performed in accordance with MIL-I-6181B, MIL-I-16910A(SHIPS), MIL-I-26600(USAF) and other military specifications.

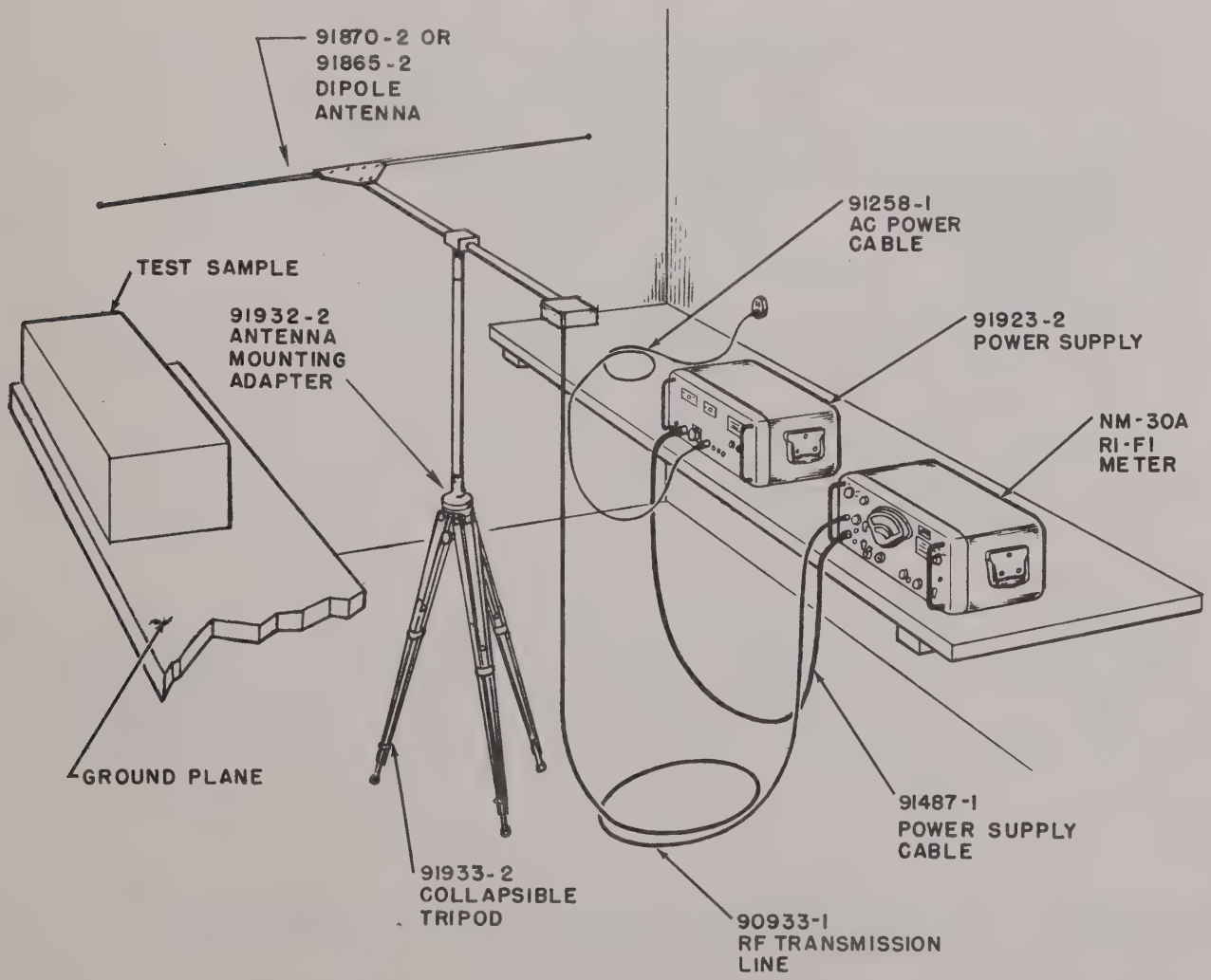


FIGURE 1-2 TYPICAL SCREEN ROOM RADIATED INTERFERENCE TEST

In the typical test configuration shown in Figure 1-3, the test sample is a transmitter with the antenna output terminated in a low VSWR dummy load.

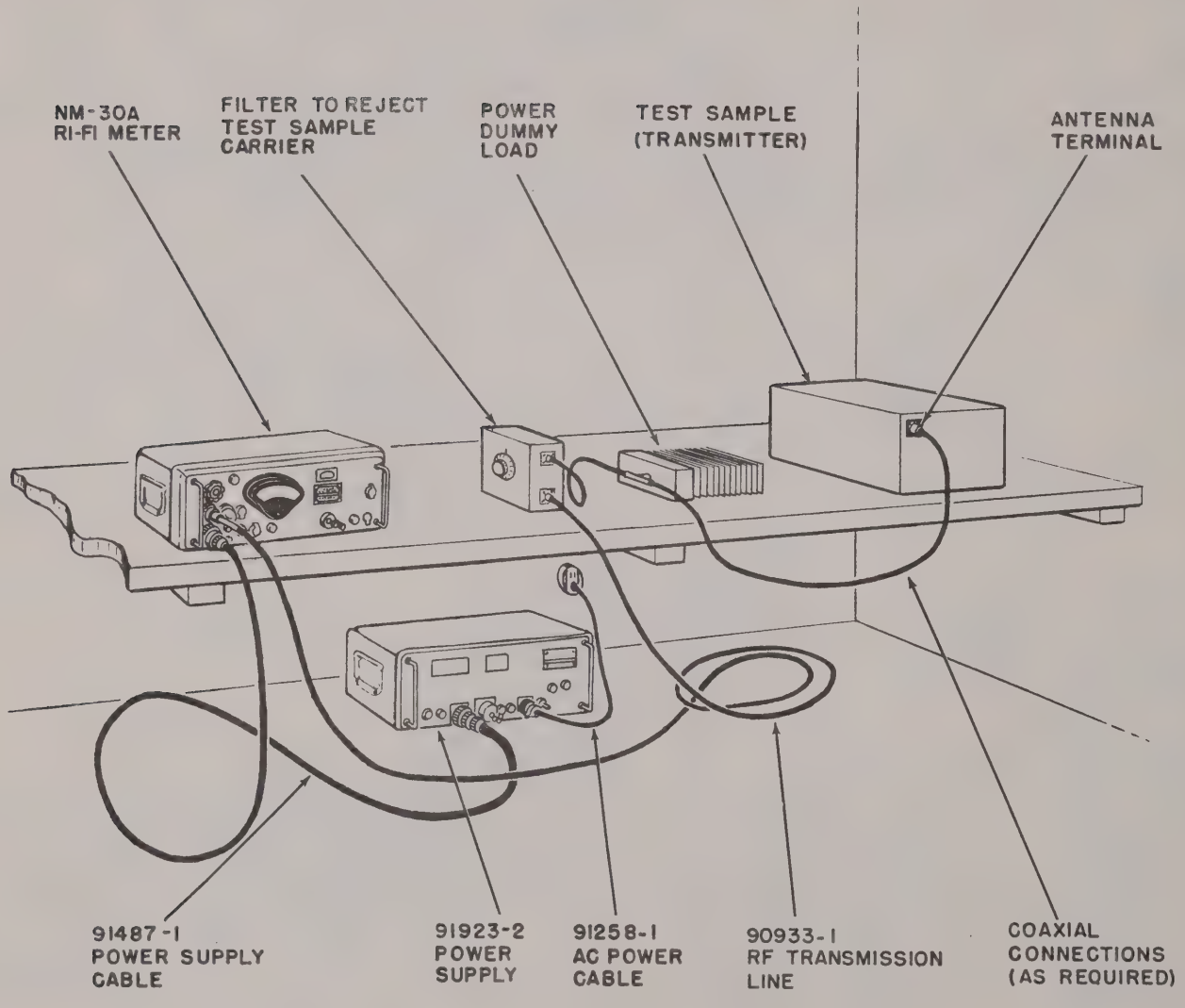


FIGURE 1-3 TYPICAL ANTENNA CONDUCTED INTERFERENCE TEST

A band rejection filter is installed to protect the NM-30A RFI Meter from the transmitter carrier. This filter must provide a high attenuation to the carrier frequency (F_c) but a low attenuation to the harmonics of F_c and to any other spurious signals in the range of 20 to 400 megacycles. If the test sample carrier itself is to lie in the frequency range of the RFI Meter, the filter should be of the bridged-T or double stub tuner type to provide the required attenuation to F_c while providing very little attenuation to conducted frequencies slightly above or below F_c. The required filter attenuation at frequency F_c is determined by the transmitter power and the spurious rejection of the RFI Meter.

Figure 1-4 shows a typical field site arrangement. In those cases where triangulation is necessary the dipole antenna should be used because the directivity pattern is more sharply defined. Magnetic north as established by a pocket compass is used for the 0-degree reference on the azimuth indicator.

2. SIGNAL INPUT DEVICES

Six signal input devices are available as part of the complete equipment. They consist of one low frequency (20-88 megacycles) and one high frequency (88-400 megacycles) adjustable dipole antenna, one ground plane adjustable vertical antenna, one loop antenna, (all of which may be used in measuring radiated signals), one RF loop probe cable, and one RF current probe. The latter two devices are used for the measurement of conducted signals. The input devices are shown in Figures 1-5, 1-6, and 1-7.

2.1 Ground Plane Vertical Antenna (91972-4). - The ground plane antenna requires a telescoping element from the low frequency dipole, or the high frequency element as supplied on the base, depending upon frequency coverage required.

If required to provide a better ground system, the antenna base will accommodate up to 24 wires, which may be located radially parallel to the earth. The length of the radial wires should be equivalent to or greater than the height of the antenna at the measured frequency. Refer to Figure 1-5.

2.2 Dipole Antennas, Low Frequency (91865-2) and High Frequency (91870-2). - In addition to measuring the strength of a radiated signal, these antennas are used when determining the direction of the signal source. These dipole antennas may be adjusted for frequency, type of polarization, and incident angle of the intercepted signal. The measuring tape, read directly in megacycles, is used when adjusting the antenna telescoping sections and the balun shorting bar to

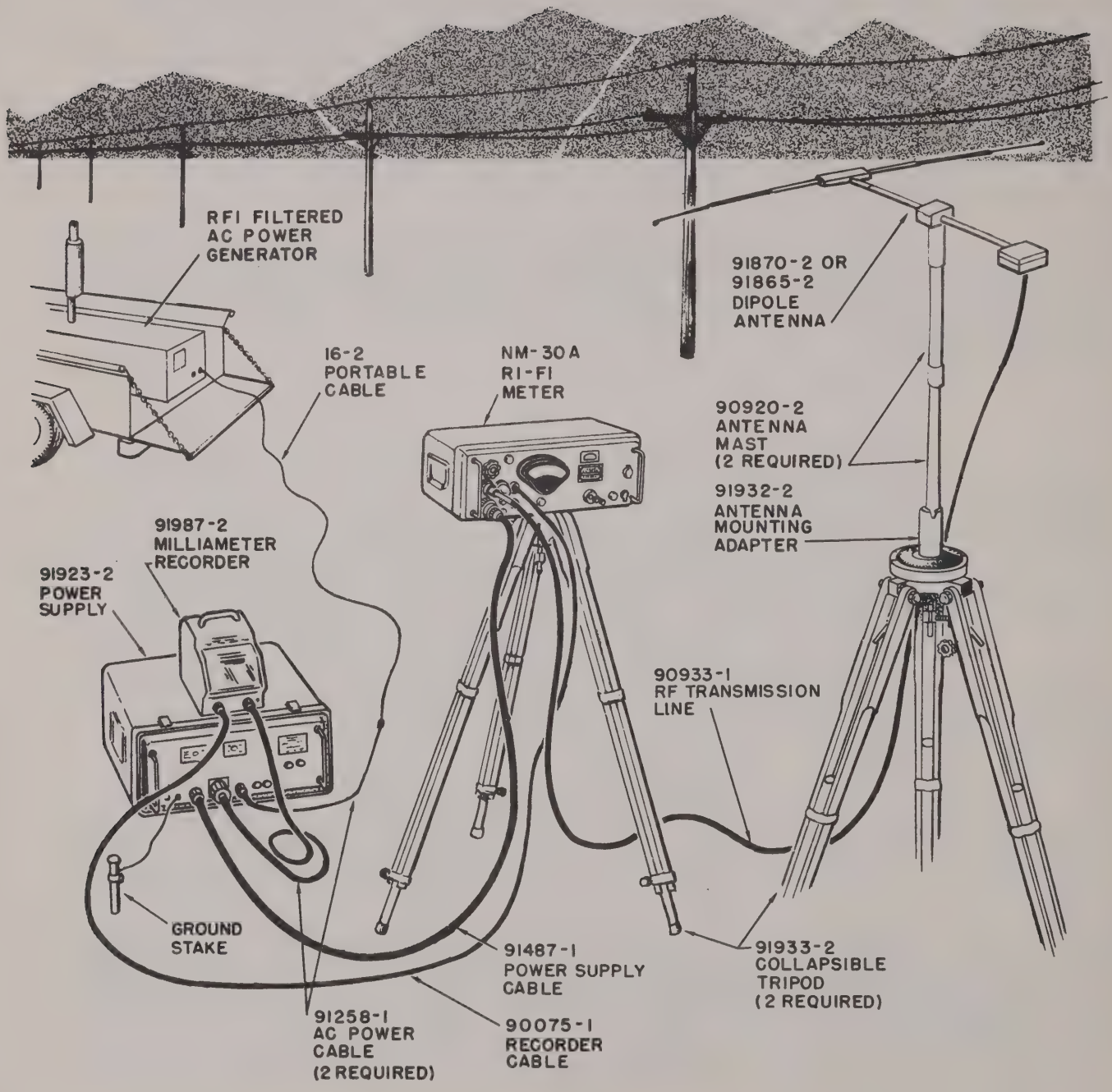


FIGURE 1-4 TYPICAL FIELD SITE

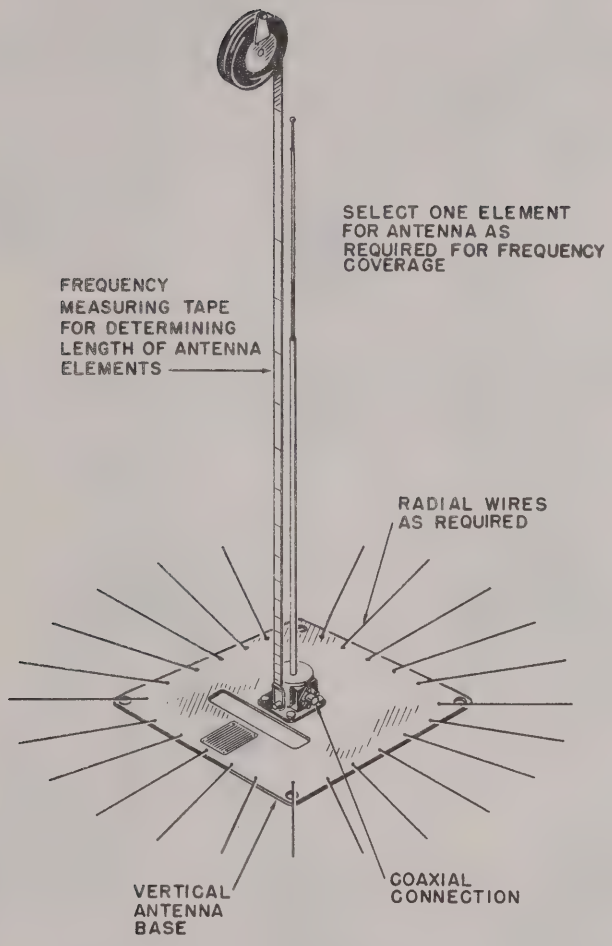

SELECT ONE ELEMENT FOR ANTENNA AS REQUIRED FOR FREQUENCY COVERAGE
FREQUENCY MEASURING TAPE FOR DETERMINING LENGTH OF ANTENNA ELEMENTS
RADIAL WIRES AS REQUIRED
VERTICAL ANTENNA BASE
COAXIAL CONNECTION

FIGURE 1-5 GROUND PLANE VERTICAL ANTENNA

the frequency of operation, the latter on the high frequency antenna only. A broadband balun coil is included with the low frequency dipole, and does not require tuning.

2.3 Loop Antenna (90799-2). - The loop antenna may be used on any frequency covered by the NM-30A (20-400 megacycles). Since the housing is insulated, it may be used as a probe in close proximity to the source of the signal. It may be hand-held, mounted on the loop antenna base, mast section, or on the tripod, as when determining the direction of a signal source. The maximum signal intensity pickup is obtained when the plane of the loop is in line with the signal source.

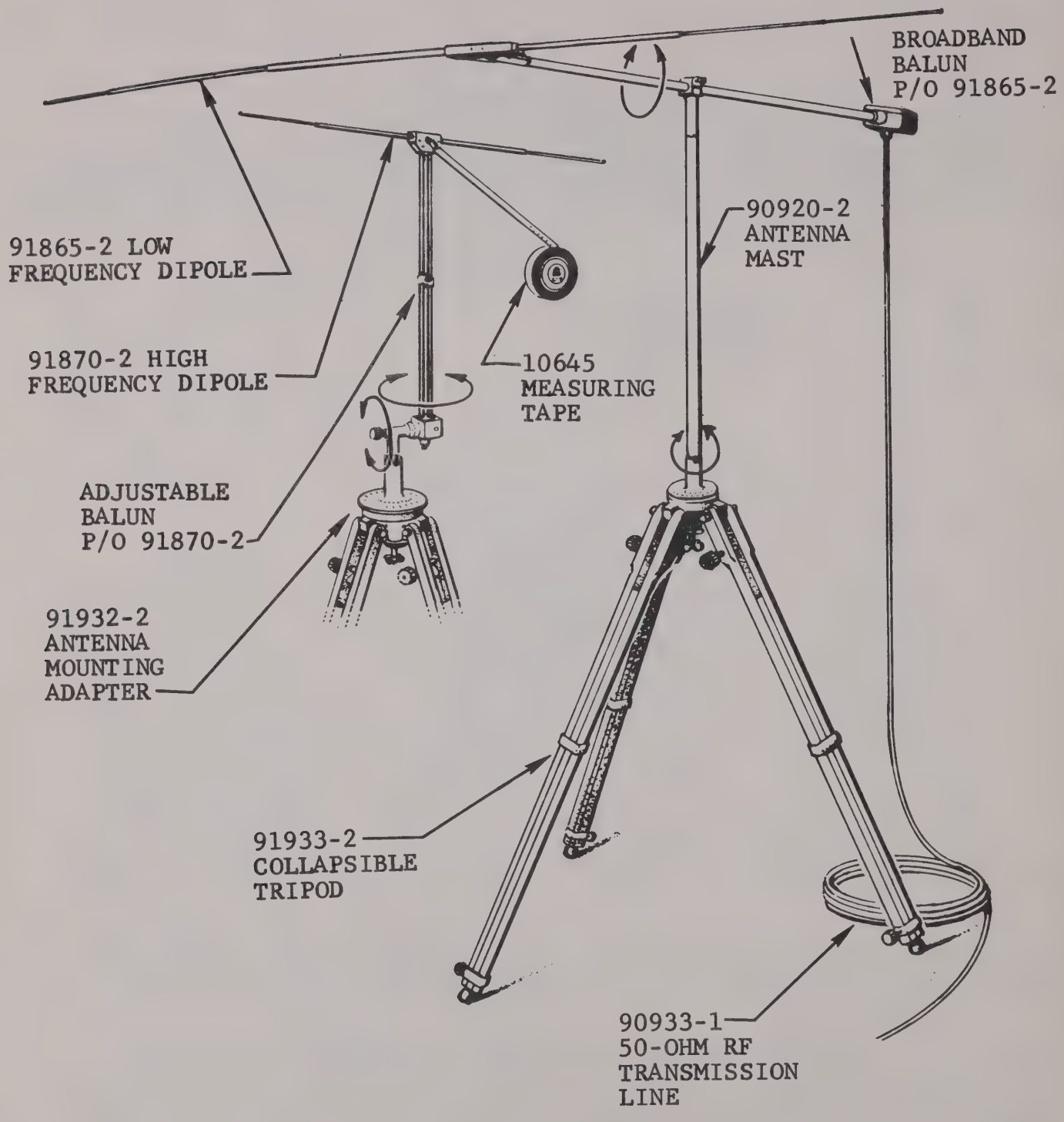


FIGURE 1-6 DIPOLE ANTENNA ASSEMBLIES

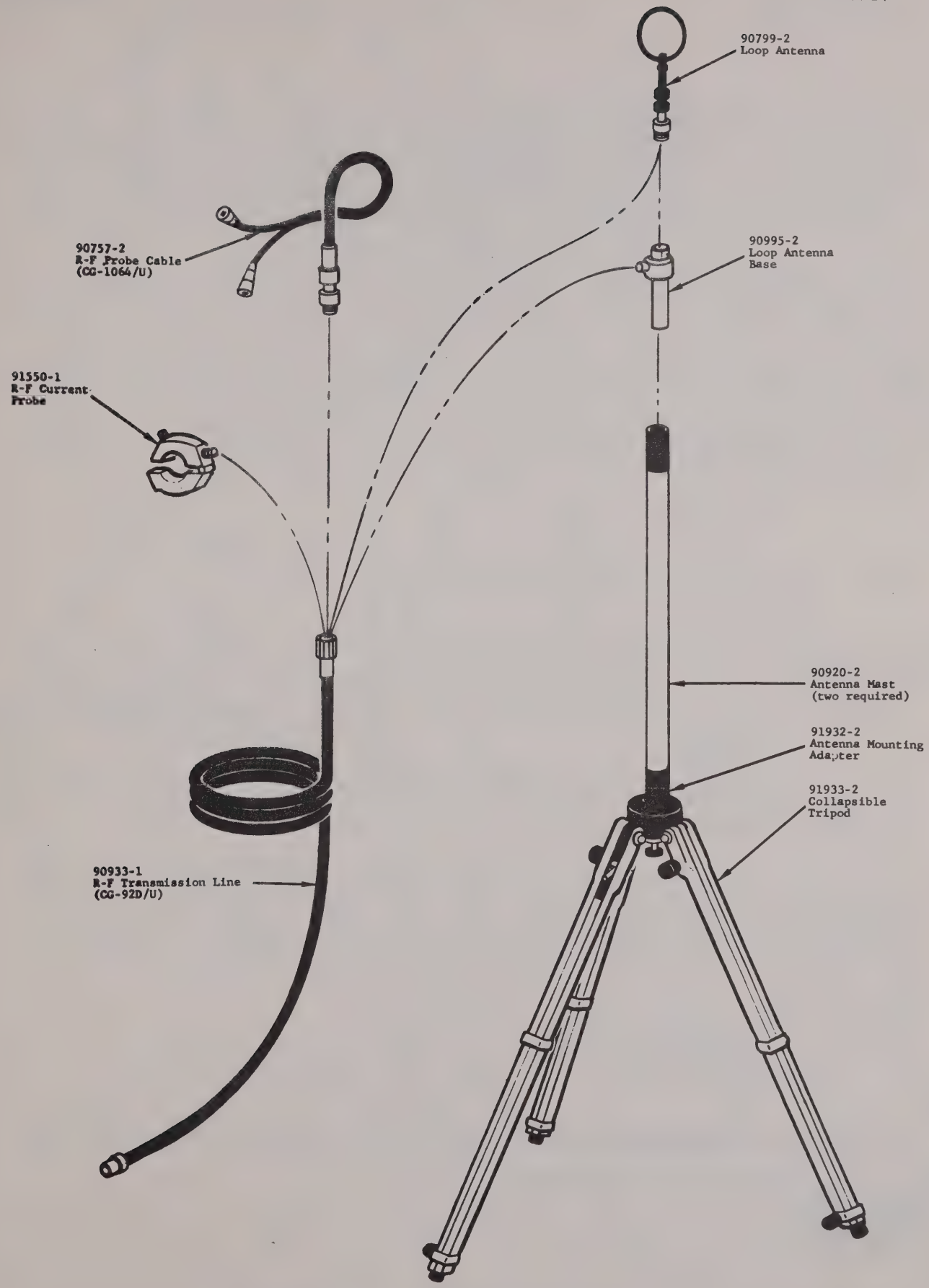


FIGURE 1-7 INPUT DEVICES

2.4 RF Probe Cable (90757-2). - The RF probe cable consists of a pair of electrical clips at the end of an 18 inch length of 50 ohm transmission line and is used for direct pick up of conducted signals. The clip may be connected across a maximum voltage of 1000 volts rms, up to 400 cycles. Standard precautions for handling high voltage must be observed by the operator.

2.5 RF Current Probe (91550-1). - The RF current probe is a clamp-on type of RF current transformer, calibrated and usable within the frequency range of 30 cycles to 100 megacycles. The probe may be clamped onto a conductor or group of conductors having a maximum size of 1-1/4 inches in diameter. The AC or DC current in the circuit under investigation must not exceed 350 amperes, otherwise core saturation in the probe negates the calibration. Voltage limitations are equivalent to the insulation capabilities of the conductor being tested. This probe is approved for use in measuring conducted radio interference currents in accordance with Military Specifications MIL-I-26600 (USAF) and MIL-I-6181D.

3. OUTPUT DEVICES

In addition to the meter of the RFI instrument, a variety of other output indications are obtainable. Refer to Figure 1-8.

3.1 Remote Meters and Extension Cable. - In situations where a remote meter is required, two such instruments may be provided as standard accessories. Either of the meters may be connected to the RFI Meter by means of a 20 foot REMOTE METER CABLE (90075-2). When a remote meter is used, it will indicate the same value as read on the NM-30A indicating meter.

3.2 Remote Meter, Standard (90078-11). - This remote meter is identical to the meter in the central system, and is used when adjustment of antennas puts the operator out of visual range of the central meter.

3.3 Remote Meter, Slow Speed (90078-10). - The slow speed remote meter is similar physically to the standard remote meter; however, it differs electrically in that it has a response time of 2 to 3.5 seconds. The meter is especially adaptable where irregular bursts of random noise, such as atmospherics, may cause difficulty in making quasi-peak measurements.

NOTE

When using the 90078-10 Slow Speed Remote Meter, the METER switch should be in the NORMAL position.

3.4 Headphones (10796) and Headphone Extension Cable (90074-1). - The headphones supplied with this equipment have a five foot cable with plug.

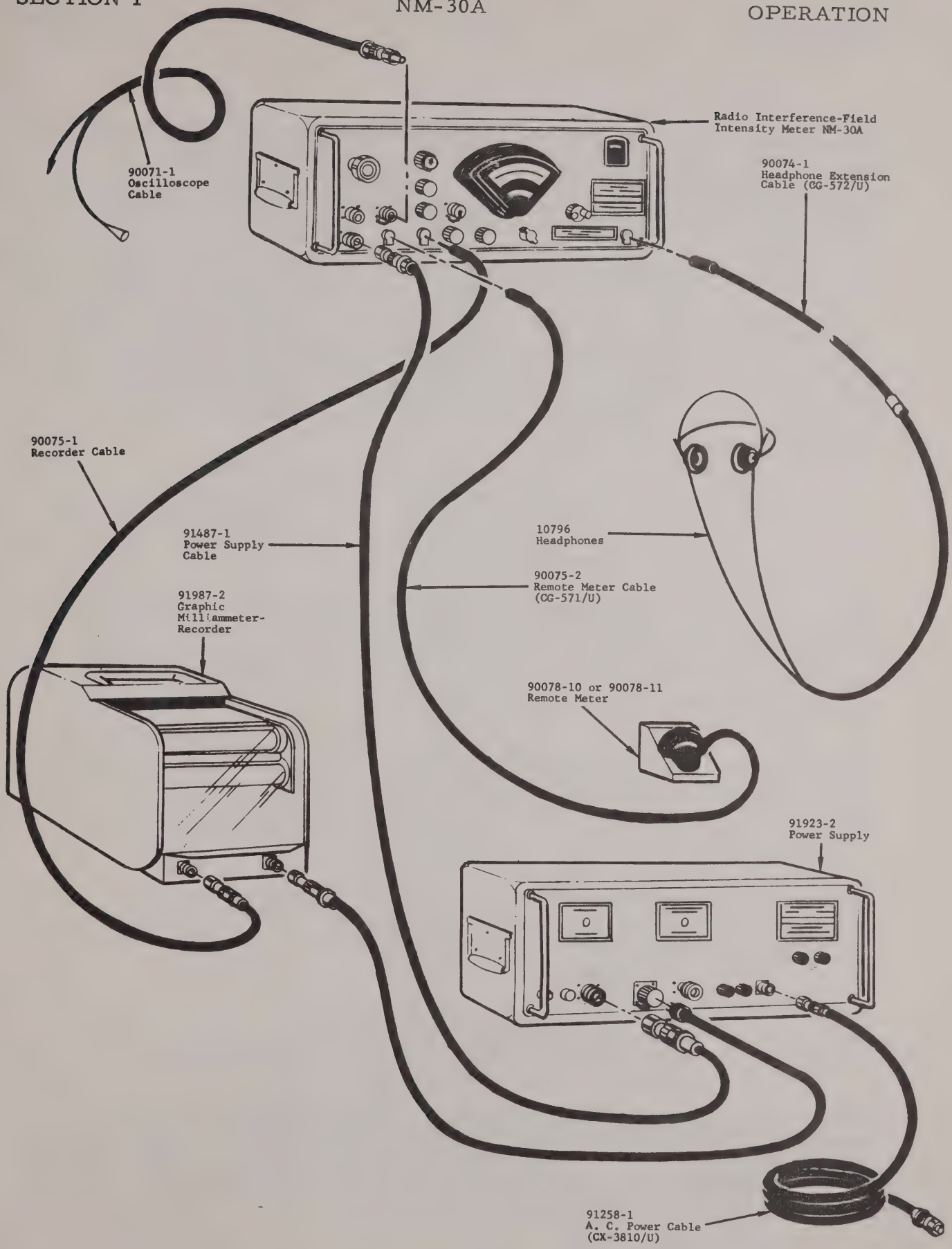

Radio Interference-Field Intensity Meter NM-30A
90071-1 Oscilloscope Cable
90074-1 Headphone Extension Cable (CG-572/U)
90075-1 Recorder Cable
91487-1 Power Supply Cable
10796 Headphones
90075-2 Remote Meter Cable (CG-571/U)
91987-2 Graphic Milliammeter-Recorder
90078-10 or 90078-11 Remote Meter
91923-2 Power Supply
91258-1 A. C. Power Cable (CX-3810/U)

FIGURE 1-8 OUTPUT DEVICES

Where remote operation of the headphones is required, the 20 foot extension is used. If speaker operation is desired, a matching transformer (600 ohms to speaker voice coil impedance) is required to drive a low impedance speaker. The latter two items are not available as standard accessories. The audio power output is nominally 150 milliwatts.

3.5 Milliammeter Recorder. - 60 Cycle Drive (91987-2)
50 Cycle Drive (91987-3)
Spring Drive (91987-4)

When graphic output recordings are required three similar recorders are available. Their main difference is in the drive power required. All recorders have chart speeds of 0.75, 1.5, 3.0, 6.0, and 12.0 inches per hour, or inches per minute, as supplied with the recorder. The following items are furnished:

Recorder Instruction Manual	(11515)
Chart Paper, 100 foot roll	(11511)
Red Ink, 2 oz. bottle	(11512)
Pen Cleaner	(11514)
Filler-Primer Syringe	(11513)

3.6 Recorder Input Cable (90075-1) and Power Cable, 6 Foot (91285-1). - These cables are required as electrical linkages to the RFI Meter. Simultaneous recording of the received signals is accomplished without disabling the instrument output meter. A detailed description of the recorder is contained in the manual supplied with the equipment.

3.7 Visual Monitoring. - The signal can be monitored visually by connecting an oscilloscope to the appropriate output jack (J107). The oscilloscope cable (90071-1), having a BNC type connector on one end and spade lugs on the other end of the line is the recommended cable for this purpose. The nominal frequency response is 20 through 100,000 cycles ± 3 db.

CAUTION

The OSCILLOSCOPE output is a high-impedance as it is connected directly to the plate of the detector. Do not load the output with 50 ohms as this will short the detector.

NOTE

Do not rely on the meter scale indication with any device connected to the OSCILLOSCOPE output unless the meter is checked on the signal both with and without the external load.

3.8 Intermediate Frequency Output Jack. - The 15 megacycles intermediate frequency of the equipment is brought out to a 50 ohm jack. It may be used for double conversion, panoramic display, or many other conditions not necessarily required as the basic function of this equipment. This is an added feature which increases the overall utility of the system.

4. EQUIPMENT CONTROLS AND RECEPTACLES

The operating controls of the RFI Meter and the power supply are located on the front panels of the units. The receptacles to which external connections are made are also located on the front panels. The function of each control and receptacle is designated by an adjacent panel marking. In the following table the panel marking is explained and the applicable symbol designation is given in parentheses after the legend to aid in identifying the circuit components. As another means of identification, control knobs are marked with a letter. These letters precede the panel markings in the following table. The front panel controls are shown in Figure 1-10.

DESIGNATION AND FUNCTION OF PANEL CONTROLS AND RECEPTACLES, NM-30A RFI METER

LEGEND	FUNCTION
(A) - PULL-TURN-PUSH (S101, E136 thru E141)	Attenuates signal for "on scale" meter indication.
RF INPUT (J101)	RF input receptacle.
POWER (J106)	Power input receptacle.
OSCILLOSCOPE (J107)	Oscilloscope receptacle for visual monitoring.
REMOTE METER (J110)	Receptacle for remote meter connection.
PEAK (I102)	Indicator lamp to provide a visual null indication.
PEAK MODE (S104)	Three-position switch to select manual or two speed automatic peak operation as follows: MANUAL - Peak measurements (broad and narrow band) obtained by manual operation of the PEAK control (R231). AUTO - Peak measurements (broad and narrow band) for automatic slow scanning (five minutes/band). SCAN - Peak measurements (broad and narrow band) for automatic fast scanning (one minute/band).

NOTE

The PEAK MODE switch should be set to the MANUAL position when using the FIELD INTENSITY, QUASI-PEAK, or BFO positions of the function switch (S102).

LEGEND	FUNCTION
(D) - CALIBRATE (R128)	Standardize instrument gain.
RECORDER (J111)	Receptacle for milliammeter-recorder connection.
(C) - PEAK (R231)	Control for furnishing slide-back voltage for peak measurements.
(F) - AUDIO (R102)	Adjusts aural monitoring level.
(B) - FUNCTION (S102)	Five-position switch to select desired operating function as follows: CAL - Position used for standardizing instrument gain. FIELD INTENSITY - Position used for narrowband signal measurement. QUASI-PEAK - Position used for scanning and narrowband signal measurements. PEAK - Position used for broadband PEAK measurements. BFO - Energizes beat frequency oscillator and disables indicating meter.
(G) - BANDSWITCH	Selects desired frequency band.
(H) - TUNING	Selects desired frequency.
PHONES (J103)	Headphone receptacle for aural monitoring.
AGC (S111)	Two-position switch concentric with AUDIO control: Permits AGC to be disabled in OFF position when a lower frequency RFI Meter is connected to the 15 Mc 50 OHM IF OUTPUT. NOTE The meter, M101, is not operative when S111 is in the OFF position.
METER (S112)	Selects desired response time of the panel meter, M101, Remote Meter (J110), and Recorder (J111), as follows: NORMAL - Provides normal meter response characteristics. SLOW - Lengthens meter response time.

"X" OUTPUT (J118)	Receptacle providing frequency analog voltage to external X-Y plotter.
15 Mc 50 OHM IF OUTPUT (J117)	Makes 15 Mc IF output available for optional second conversion receiver (NM-22A or other equipment).

POWER SUPPLY

GROUND	Ground post for connection to external ground.
F301, F302	Active 2 ampere line fuses.
F303, F304	Spare 2 ampere fuses.
F305	3/16 ampere B + fuse.
I131	Power-on indicator lamp.
POWER OUTPUT (J301)	Receptacle for operating potential supply to RFI Meter.
RECORDER CHART DRIVE (J303)	Power source for graphic recorder provides a 115 volt ac 15 watt supply. Used only when external power frequency is 60 cycles.
POWER (S301) -ON-	Energizes the equipment..
-OFF-	De-energizes the equipment.
POWER INPUT (J302)	Receptacle for external source input power.

5. DESCRIPTION OF CHART SET No. 91036

The chart set consists of a series of eleven vinylite sheets containing operating instructions and a family of calibration curves that are plotted for each individual RFI Measuring Equipment. The first page supplies simplified operating instructions, including instructions for the proper use of the curves on the succeeding pages.

6. BASIC OPERATING PROCEDURES

Specific operational procedures for detecting and measuring RF signals with the NM-30A equipment will vary depending upon the purpose of measurement and type of signal being measured; however, the basic operating procedure which will generally apply for all measurement conditions is outlined in the following steps. (The word "Signal" as used herein, refers to any RF input to the equipment.)

1) Determination and adjustment of appropriate signal pickup device. (See para. 2, page 1-5)

2) Search for signal.

3) Determination of type of signal (narrowband or broadband).

4) Standardizing the instrument gain (calibration).

5) Signal measurement.

6) Calculating measured signal level.

6.1 Signal Search. - Refer to Figure 1-9 (Page 1-31). The procedure for searching for the frequency range covered by the NM-30A for signals is as follows:

1) PULL attenuator knob (A) out, TURN to X1, PUSH in.

2) Turn FUNCTION SWITCH (B) to QUASI-PEAK.

3) Turn CALIBRATE control (D) for a two microvolt indication on the meter with no signal applied.

4) Slowly rotate TUNING control (H) through the frequency range while observing the meter and listening to headphones for signal indication. Turn BAND-SWITCH (G) to change frequency ranges. Adjust AUDIO control (F) for comfortable listening level.

6.2 Determination of Signal Type. - The proper calibrating level, detector function, and method of calculating measured signal levels depend upon whether the signal is narrowband or broadband. All types of signals regardless of origin fall into one of these categories.

(a) Narrowband Signals. - A narrowband signal is defined broadly as any signal having a spectrum that is narrow compared with the nominal 6 db bandwidth of the measuring equipment. Narrowband signals will appear "sharply tuneable" when tuning across the spectrum. Continuous wave signals are always narrowband signals. For the NM-30A equipment, the following are also considered narrowband signals:

1) AM or SSB modulation.
2) FM or NBFM modulation.
3) Frequency-shift keying.
4) Facsimile.

Narrowband signals are measured with the function switch in the FIELD INTENSITY or QUASI-PEAK position.

(b) Broadband Signals. - A broadband signal is defined as any signal having a spectrum that is broad compared with the nominal impulse bandwidth of the RFI Meter. Broadband signals or interference can be considered as consisting of sharp pulses. If the pulses are relatively infrequent and clearly separated, the signal is termed "impulsive". Impulse signals can be generated by internal combustion engines, power line discharges (other than corona) sparking of motor brushes, and by other electrical and electromechanican devices. If the pulses follow each other rapidly and overlap, and are not clearly distinguishable, the signal is called "random". Thermal agitation is a type of random interference. Atmospheric interference, or static, originating in lightning discharges is random interference in that the impulses are frequent and overlap, with sharp peaks that exceed the average level. Since the frequency spectrum of such discontinuous signals is broad, the indicated magnitude will depend upon the bandwidth of the measuring equipment. The indicated amplitude of impulse signals is directly proportional to the impulse bandwidth of the RFI Meter. For the NM-30A RFI Meter, the following are usually considered broadband signals:

1) Random noise (cosmic noise, corona discharge, shot noise as from diodes and tubes).

2) Video AM modulation.

3) Narrow-pulse radar.

4) Impulse noise from machines.

Since random signals are broadband in nature, their indicated amplitude is also a function of the bandwidth of the measuring instrument; however, because of the overlapping character of the pulses that make up random signals, the indicated amplitude varies as the square root of the random noise bandwidth.

Broadband signals may be measured with the function switch in the PEAK or QUASI-PEAK position. The QUASI-PEAK position is sometimes chosen for the measurement of random signals but impulse signals are usually measured with the function switch in the PEAK position.

Most military interference specifications require all broadband interference to be measured in the PEAK detector function and impulse bandwidth data be used for final calculations.

6.3 Standardizing the Gain. - Refer to Figure 1-10.

NOTE

Before the instrument can be used for measurement, it is necessary to standardize the gain at the specific measurement frequency. When the measurement frequency is changed the gain must again be standardized.

1) PULL attenuator knob (A) out, TURN to CAL, PUSH in.

2) Turn function switch (B) to CAL, and PEAK MODE switch to MANUAL.

3) Turn CALIBRATE control (D) left to stop.

4a) For NARROWBAND MEASUREMENTS: Refer to Chart 1 or 2 of the chart set for correct calibration level at desired frequency, then turn PEAK control (C) until meter pointer indicates this level on db scale.

4b) For BROADBAND MEASUREMENTS: Turn PEAK control (C) until meter pointer indicates the level given on the first page of chart set for broadband measurements.

5) Turn CALIBRATE control (D) right until PEAK lamp (I) glows, then left until lamp just ceases to light (ignore occasional blink of lamp). The gain of the RFI Meter is now standardized at this frequency. Do not readjust the CALIBRATE control (D) until the RFI Meter is again standardized for gain at this or another frequency.

6.4 Signal Measurement. -

a. Narrowband Signal Measurement. - Refer to Figure 1-9.

1) STANDARDIZE GAIN at signal measurement frequency for NARROWBAND MEASUREMENTS.

2) Turn function switch (B) to FIELD INTENSITY (use QUASI-PEAK to measure carrier-plus-modulation of an amplitude modulated signal.

3) Set attenuator (A) to X1 position. Adjust TUNING (H) for maximum signal indication on meter. If meter indication exceeds full scale increase attenuator (A) one step at a time for an indication between 10 and 100 microvolts. Return if necessary.

4a) For CONDUCTED MEASUREMENTS: Multiply meter indication in microvolts by the attenuator setting and appropriate correction factor from Charts 1 or 2.

4b) For RADIATED MEASUREMENTS: Multiply the result of Step 4a by the appropriate antenna factor from Chart 4 or 5 to obtain final values in microvolts-per-meter.

b. Broadband Signal Measurements. -

1) STANDARDIZE GAIN at signal measurement frequency for BROADBAND MEASUREMENTS.

2) Turn FUNCTION SWITCH (B) to PEAK.

3) Turn PEAK control (C) for full scale meter indication.

4) Set attenuator (A) to X1 position. If PEAK lamp (I) is glowing, advance attenuator one step at a time until lamp is extinguished.

5) Turn PEAK control (C) left until PEAK lamp (I) glows, then slowly turn right until lamp just ceases to blink.

6a) For CONDUCTED MEASUREMENTS: Multiply the meter indication in microvolts by the attenuator setting and divide the result by 100 to obtain the final peak value in terms of microvolts-per-kilocycle, or multiply the result by 10 to obtain the final peak value in terms of microvolts-per-megacycle. An alternative method using db values is as follows: Add the attenuator setting in db to the meter indication in db. Subtract 40 db from the result to obtain the final peak value in db above one microvolt-per-kilocycle, or add 20 db to the result to obtain the final peak value in db above one microvolt-per-megacycle.

6b) For RADIATED MEASUREMENTS: Multiply the results of Step 6a by the appropriate antenna factor from Chart 4 or 5 to obtain the final peak values in microvolts-per-kilocycle (or per megacycle) -per-meter.

7. MEASURING BROADBAND INTERFERENCE IN ACCORDANCE WITH MILITARY MEASUREMENT SPECIFICATIONS

The following procedure permits the measurement of broadband interference in terms of microvolts-per-kilocycle or db above one microvolt-per-megacycle without involving complicated bandwidth computations. Its simplicity is based on the fact that the output of the internal calibrator is a constant value per unit bandwidth throughout the frequency range of the NM-30A equipment. To insure accuracy, the calibrator in each equipment is individually measured and its output is recorded as a CALIBRATION SETTING in decibels on the first page of the chart set.

This equipment has been calibrated in terms of RMS of a sine wave (0.707 of the true peak of a sine wave). Peak values are therefore in terms of RMS of a sine wave which would have the same peak amplitude as the impulse signal that appears at the second detector input. Military specification broadband limits are in these same terms. Other specifications may require broadband measurements to be stated in terms of true peak calibration instead of an RMS calibration. In these cases, the meter indication should be multiplied by a factor of 1.41.

The applicable specification should be consulted to determine the proper value required.

7.1 Conducted Measurements. -

a. In Terms of Microvolts-per-Kilocycle:

Applicable Military Specifications:

MIL-I-16910A(SHIPS) 30 August, 1954, Figure 10, "Broadband Conducted Interference Expressed in Terms of Standard Units."

1) Standardize the equipment gain a t the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set using the CALIBRATION SETTING provided in Step 7.

2) Take a PEAK or "slide-back" measurement of the broadband interference signal. Use either visual or aural method of measurement.

This meter reading is equivalent to a bias voltage (introduced by the PEAK control) that is identical to the effective peak value of the input signal as seen by the second detector.

3) Divide the indicated reading (meter scale reading times the attenuator setting) by a bandwidth factor of 100 to obtain the final peak value of the conducted signal in microvolts-per-kilocycle across 50 ohms.

NOTE

When using the CALIBRATION SETTING provided on the first page of the chart set, step 7, the 20 foot RF cable loss is compensated for only at 125 megacycles. A maximum error of 4 percent occurs at either end of the frequency range. If greater accuracy is desired, RF cable losses must be taken into account. Multiply the final value of Step 3 (above) by the appropriate correction factor from Chart 9 to obtain final corrected values.

EXAMPLE

FREQUENCY	26 Megacycles
METER READING	40 Microvolts
ATTENUATOR SETTING	20 db (X10)
CABLE LOSS FACTOR	0.963 (From Chart 9)

Then, as outlined in Step 3,

$$\frac{40 \times 10}{100} = 4.0 \text{ microvolts-per-kilocycle across 50 ohms}$$

Correcting for cable loss, Step 4,

$$4.0 \times 0.963 = 3.852 \text{ microvolts-per-kilocycle across 50 ohms}$$

b. In Terms of db Above One Microvolt/Megacycle:

Applicable Military Specifications:

MIL-I-16910A (SHIPS) 30 August, 1954, Figure 10, "Broadband Conducted Interference Expressed in Terms of Standard Units."

1) Standardize the equipment gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set using the CALIBRATION SETTING provided in Step 7.

2) Take a PEAK or "slide-back" measurement of the broadband interference signal. Use either visual or aural method of measurement.

3) For conductive measurements add 20 db to the indicated reading (meter scale reading in db plus the attenuator setting in db) to obtain the final peak value of conducted signal in db above one microvolt-per-megacycle across 50 ohms.

4) If greater accuracy is desired, add cable losses to final cable correction chart 9.

EXAMPLE

FREQUENCY	200 Megacycles
METER READING	32 db
ATTENUATOR SETTING	40 db ($X10^2$)
CABLE LOSS	+0.140 db (From Chart 9)

Then, as outlined in Step 3, 20 db + 32 db + 40 db = 92 db above one microvolt-per-megacycle across 50 ohms.

Correcting for cable loss, Step 4, 92 + 0.14 db = 92.14 db above one microvolt-per-megacycle across 50 ohms.

7.2 Radiated Measurements

a. In Terms of Microvolts-per-Meter-per-Kilocycle:

Applicable Military Specifications:

MIL-I-16910A(SHIPS) 30 August, 1954, Figure 7, "Broadband Radiated Interference Limits Expressed in Terms of Standard Units."

NOTE

The antenna shall be a tuned dipole.

1) Standardize the equipment gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set using the CALIBRATION SETTING provided in Step 7.

2) Take a PEAK or "slide-back" measurement of the broadband interference signal. Use either visual or aural method of measurement. This meter reading is equivalent to a bias voltage (introduced by the PEAK control) that is identical to the effective peak value of the input signal as seen by the second detector.

3) Divide the indicated meter reading (meter scale reading times the attenuator setting) by a bandwidth factor of 100 to obtain a value of microvolts-per-kilocycle. Multiply this quantity by the appropriate antenna factor from Charts 4 and 5. This result will be the final value of field intensity in microvolts-per-meter-per kilocycle.

4) If greater accuracy is desired, RF cable losses must be taken into account. Multiply the final value of Step 4 by the appropriate correction factor from Chart 9 to obtain final corrected value.

EXAMPLE

FREQUENCY	50 Megacycles
METER READING	70 Microvolts
ATTENUATOR SETTING	40 db ($X10^2$)
DIPOLE FACTOR	1.3 (From Chart 4)
CABLE LOSS FACTOR	0.974 (From Chart 9)

Then, as outlined in Step 3,

$$\frac{70 \times 10^2 \times 1.3}{100} = 91.0 \text{ microvolts-per-meter-per-kilocycle}$$

Correcting for cable loss, Step 4,

91.0 x 0.974 = 88.634 microvolts-per-meter-per kilocycle.

a. In Terms of Antenna Induced Microvolts/Kilocycle Bandwidth:

Applicable Military Specification:

MIL-I-6181B, 29 May, 1953, Figure 17, "Standard Limits Broadband Radiated Interference."

NOTE

This procedure applies only when using tuned dipole antenna.

1) Standardize the equipment gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set using the CALIBRATION SETTING provided in Step 7.

2) Take a PEAK or "slide-back" measurement of the broadband interference signal. Use either visual or aural method of measurement. This meter reading is equivalent to a bias voltage (introduced by the PEAK control) that is identical to the effective peak value of the input signal as seen by the second detector.

3) Divide the indicated meter reading (meter scale reading times the attenuator setting) by a bandwidth factor of 100 to obtain a value in microvolts-per-kilocycle. Multiply this quantity by an antenna factor of 2.51. This result will be the final value of the signal in antenna induced microvolts-per-kilocycle bandwidth.

4) If greater accuracy is desired, RF cable losses must be taken into account. Multiply the final value of Step 3 above by the appropriate correction factor from Chart 9 to obtain final corrected value.

EXAMPLE

FREQUENCY	30 Megacycles
METER READING	60 Microvolts
ATTENUATOR SETTING	$X10^3$
CABLE LOSS FACTOR	0.965 (From Chart 9)
ANTENNA FACTOR	2.51 (See Step 3)

Then, as outlined in Step 3,

$$\frac{60 \times 10^3 \times 2.51}{100} = 1,506$$ antenna induced microvolts-per-kilocycle bandwidth

Correcting for cable loss, Step 4,

$1,506 \times 0.965 = 1,453.29$ antenna induced microvolts-per-kilocycle bandwidth

c. In Terms of db Above One Microvolt/Mc Antenna Induced:

Applicable Military Specification:

MIL-I-26600(USAF) 2 June, 1958, Figure 8, "Broadband and Pulsed CW Radiated Interference Limits."

1) Standardize the equipment gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set using the CALIBRATION SETTING provided in Step 7.

2) Take a PEAK or "slide-back" measurement of the broadband signal. Use the db scale. Use either visual or aural method of measurement. This meter reading is equivalent to a bias voltage (introduced by the PEAK control) that is identical to the effective peak value of the input signal as seen by the second detector.

3) Add 20 db to the indicated reading (meter scale reading in db plus attenuator setting in db) to obtain a value in db above one microvolt-per-megacycle. Add to this quantity an antenna factor of 8 db. This result will be the final value of the signal received in db above one microvolt-per-megacycle antenna induced.

4) If greater accuracy is desired, RF cable losses must be taken into account. Add to the final value of Step 3 the appropriate db correction from Chart 9 to obtain final correction value.

EXAMPLE

FREQUENCY	65 Megacycles
METER READING	37 db
ATTENUATOR SETTING	20 db
CABLE LOSS	-0.17 db (From Chart 9)
ANTENNA FACTOR	8 db (From Step 3)

Then, as outlined in Step 3,

20 db + 37 db + 20 db + 8 db = 85 db above one microvolt-per-megacycle antenna induced

Correcting for cable loss, Step 4,

85 db -0.17 db = 84.83 db above one microvolt-per-megacycle antenna induced

8. MEASURING NARROWBAND AND RADIATED INTERFERENCE IN ACCORDANCE WITH MILITARY MEASUREMENT SPECIFICATIONS

8.1 a. In Terms of Antenna Induced Microvolts:

Applicable Military Specification:

MIL-I-6181B, 29 May, 1953, Figure 18, "Standard Limits CW Interference."

NOTE

This procedure applied only when using a tuned dipole antenna.

1) Standardize the gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set and use the CALIBRATION SETTING provided on Charts 1 and 2.

2) Rotate FUNCTION SWITCH (B) to FI position.

3) PULL-TURN-PUSH attenuator knob (A) to select appropriate attenuation for meter reading in upper portion of the scale where possible.

4) Multiply the meter reading in microvolts by appropriate correction factor from Charts 1 and 2 and by the attenuator setting to obtain RF input microvolts across 50 ohms. Multiply this quantity by an antenna factor of 2.51 for final result in antenna induced microvolts.

EXAMPLE

FREQUENCY	170 Megacycles
METER READING	70 Microvolts
ATTENUATOR SETTING	$X10^2$
CORRECTION FACTOR	2 (See Step 4)
ANTENNA FACTOR	2.51 (See Step 4)

Then, as outlined in Step 4,

$70 \times 2 \times 10^2 \times 2.51 = 35,140$ antenna induced microvolts

8.2 b. In Terms of db Above One Microvolt Antenna Induced:

Applicable Military Specification:

MIL-I-26600(USAF) 2 June, 1958, Figure 6, "Narrowband CW Radiated Interference Limits."

NOTE

This procedure applies only when using a tuned dipole antenna.

1) Standardize the gain at the test frequency, following the procedure given in Steps 1 through 9 on the first page of the chart set and use the CALIBRATION SETTING provided on Charts 1 and 2.

2) Rotate FUNCTION SWITCH (B) to FI position.

3) PULL-TURN-PUSH attenuator knob (A) to select appropriate attenuation for meter reading in upper portion of the scale, when possible.

4) Add the meter reading in db to the attenuator setting in db. To this add the appropriate correction factor in db from Charts 1 and 2 to obtain the RF input in db above one microvolt across 50 ohms. Add to this value an antenna factor of 8 db for final value in terms of db above one microvolt antenna induced.

EXAMPLE

FREQUENCY	30 Megacycles
METER READING	23 db
ATTENUATOR SETTING	20 db
CORRECTION FACTOR	0 db (See Step 4)
ANTENNA FACTOR	8 db (See Step 4)

Then, as outlined in Step 4,

23 db + 20 db + 8 db = 51 db above one microvolt antenna induced

9. CALIBRATION AND MEASUREMENT AT REDUCED EQUIPMENT GAIN

Since the aging of tubes and other components causes loss of circuit gain, it may eventually become difficult at certain frequencies to calibrate the equipment properly using the figures given in the chart set because of insufficient CAL control range. In this case, it is still possible to calibrate the equipment accurately at reduced sensitivity.

Accurate calibration is assured because of the constant output of the calibrator over long periods of time. A new calibration figure (smaller than the original) may be arbitrarily selected. After making a measurement, the new calibration figure is simply subtracted from the figure given in the chart set and the difference applied to the meter reading of the signal under measurement. The procedure is as follows:

1) Rotate the CAL control fully clockwise.

2) Turn the PEAK control counterclockwise until the threshold is reached as indicated by flashing of the neon PEAK lamp.

3) Note the meter reading in db. This may be used as the new calibration figure.

4) Note the difference in db between this new calibration figure and that given on the calibration chart. Add this difference to the indicating meter reading of the signal.

EXAMPLE

If the calibration figure is 25 db and this cannot be made, rotate the PEAK control counterclockwise until the signal threshold is reached. Assume that at this point the indicating meter scale reads 20 db. Then, add 5 db to all signal measurements at this frequency.

NOTE

If data is taken using the microvolt scale, it would be more convenient to make the new calibrating figure 6 db less than that given on the calibrating chart. The meter indication in microvolts would then simply be multiplied by two to obtain true meter reading.

10. DERIVATION OF NM-30A DIPOLE ANTENNA CORRECTION FACTOR FOR MEASUREMENTS EXPRESSED IN TERMS OF ANTENNA INDUCED VOLTAGE

When using the NM-30A Radio Interference Measuring Equipment for radiated measurements in accordance with Specifications MIL-I-6181B and MIL-I-26600(USAF), the 91865-2 and 91870-2 dipole antennas are used and the intensity of the received interference is expressed in terms of the open circuit voltage induced in a tuned dipole antenna. When measurements are performed in accordance with MIL-I-26600 the dipole is not tuned below 35 Mc, but the tuned dipole factor is used and the lack of antenna gain is compensated for in the limit curve of Figures 6 and 8. The terms used are "Antenna Induced Microvolts" in Specification MIL-I-6181B and "db above One Microvolt Antenna Induced" in Specification MIL-I-26600(USAF).

Antenna induced voltage is the open circuit voltage in a theoretical tuned dipole in free space; therefore, to convert the input voltage to antenna induced voltage a correction must be applied to compensate for the loading of the antenna and for the impedance transfer. The NM-30A dipole antennas use "baluns" to match the nominal 72 ohm balanced impedance at the terminals of the tuned dipole to the 50 ohm unbalanced RFI Meter input impedance. The 91865-2 (20-88 Mc) dipole and the 91870-2 (88-400 Mc) dipoles use loss less baluns.

The antenna induced voltage is related to the input voltage by the following formula:

$$E(\text{Ant. Ind.}) = E \text{ Input } X \left(1 + \frac{72 \text{ ohms}}{\text{Meter Input Impedance (ohms)}}\right)$$

Factor for the 91865-2 and 91870-2 Dipoles:

$$E(\text{Ant. Ind.}) = E \text{ Input } X \left(1 + \frac{72}{50}\right) = 2.44 \text{ or } 7.76 \text{ db}$$

(The USAF used the "rounded off" figure of 8 db and its corresponding ratio of 2.51)

11. MEASUREMENT OF SIGNALS IN PRESENCE OF BACKGROUND INTERFERENCE

When a sine wave, random, or impulse (high repetition rate) signal must be measured in the presence of background interference (or internal noise) of a random nature, it is possible to correct for the background interference and determine the intensity of the desired signal. Using the RFI Meter, obtain the value of interference plus signal and also the value of "interference only". The "interference only" figure may be obtained by turning off the signal, if possible, or detuning (if signal is narrowband).

For CW measurements the NM-30A equipment is calibrated to measure the voltage at the end of the 20 foot RF cable; therefore, the input voltage is the voltage appearing at the antenna end of the 20 foot RF cable or at the 50 ohm terminal of the dipole antenna. For broadband measurements the NM-30A equipment is calibrated to measure the voltage at the input of the meter; therefore, if greater accuracy is desired, the cable correction factor from Chart 9 of the NM-30A chart set must be applied.

After obtaining the "interference plus signal" and "interference only" readings then they may be subtracted to obtain "signal only" by the following chart:

TYPE INTER-FERENCE	TYPE SIGNAL	DETECTOR FUNCTION	METHOD OF SUBTRACTION	
			Direct	RMS
Random	Sine Wave	FIELD INTENSITY		X
		QUASI-PEAK		X
Random	Random	FIELD INTENSITY		X
		QUASI-PEAK		X
Random	Impulse (High Repetition rate)	FIELD INTENSITY		X
		QUASI-PEAK	X	

Direct Subtraction:

Signal only = interference + signal - interference only

RMS Subtraction:

$$\text{Signal only} = \sqrt{(\text{interference + signal})^2 - (\text{interference only})^2}$$

Signal determination can be simplified by using the chart in Figure 1-9 which is based on the RMS subtraction formula. The chart is used as follows:

1) On chart, Figure 1-9, locate the meter reading of "interference plus signal" on horizontal scale. (Example: Assume 55 microvolts)

2) Follow the arc upward until it intersects the horizontal line which represents the "interference only" meter readings. (Example: 30 microvolts)

3) Drop down from the point of intersection to the horizontal scale and read off the corrected meter reading. This is the value of the signal in absence of the random interference. (Example: 42 microvolts)

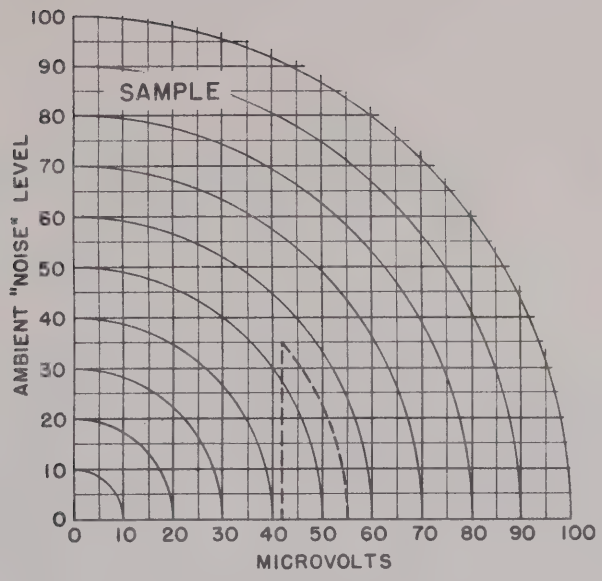


FIGURE 1-9 CHART FOR RMS SUBTRACTION OF SIGNAL FROM RANDOM INTERFERENCE BACKGROUND

1.12 USE OF THE 15 Mc 50 OHM IF OUTPUT

The 15 megacycle, 50 ohm IF output can be used in conjunction with a second conversion equipment, such as the Stoddart NM-20B, to measure sine wave signals. The narrower bandwidth of the NM-20B (less than 10 kc) results in a substantial increase in the CW sensitivity over that obtained with the NM-30A alone. In the method described below, a signal generator such as the Hewlett-Packard VHF Signal Generator Model 608-C (or equivalent) (see Table 3-1) is used to apply a known signal to the NM-30A which results in the same meter deflection on the NM-20B RFI Measuring set as does the unknown signal. In this manner the value of the unknown signal is determined.

Step 1. Connect a 50-ohm coaxial cable having a BNC type connector at one end and an N-type connector at the other to the 15 Mc 50 ohm IF OUTPUT jack of the NM-30A and to a Stoddart 90305-6 or 90305-7 50 ohm matching impedance. Connect the 90305-6 matching impedance to the NM-20B ANT input receptacle.

Step 2. Tune the NM-20B equipment for maximum indication of noise from the NM-30A. When this is done, the NM-20B will be tuned to the center of the NM-30A IF passband. Adjust gain of NM-20B for output indication of about one microvolt in X1 or X10 attenuator position.

Step 3. Connect the proper antenna assembly to J101 of the NM-30A using RF transmission cable 90933-1. Tune or scan the NM-30A RI-FI measuring set for signal measurement at the desired frequency, using bandswitch G and tuning dial H. Accurate gain standardization is not necessary. If the signal is too sharp to tune with the NM-30A tuning crank, use the NM-20B tuning crank as a vernier.

Step 4. Record the deflection of the NM-20B meter (if the meter reading runs off-scale, adjust the NM-30A attenuator accordingly).

Step 5. Disconnect the RF pickup device from the NM-30A.

Step 6. Connect the output of the signal generator (see above) to J101 of the NM-30A, using RF transmission cable 90933-1.

Step 7. With the signal generator set at the frequency being measured, adjust its output until the NM-20B indicating meter deflection is the same as that produced by the unknown signal.

Step 8. The output of the Hewlett-Packard VHF Signal Generator Model 608-C (or equivalent) indicates the RMS value of the output signal in microvolts. To convert this to an equivalent field intensity reading in microvolts-per-meter, multiply by the proper antenna correction factor from Chart 4 or Chart 5.

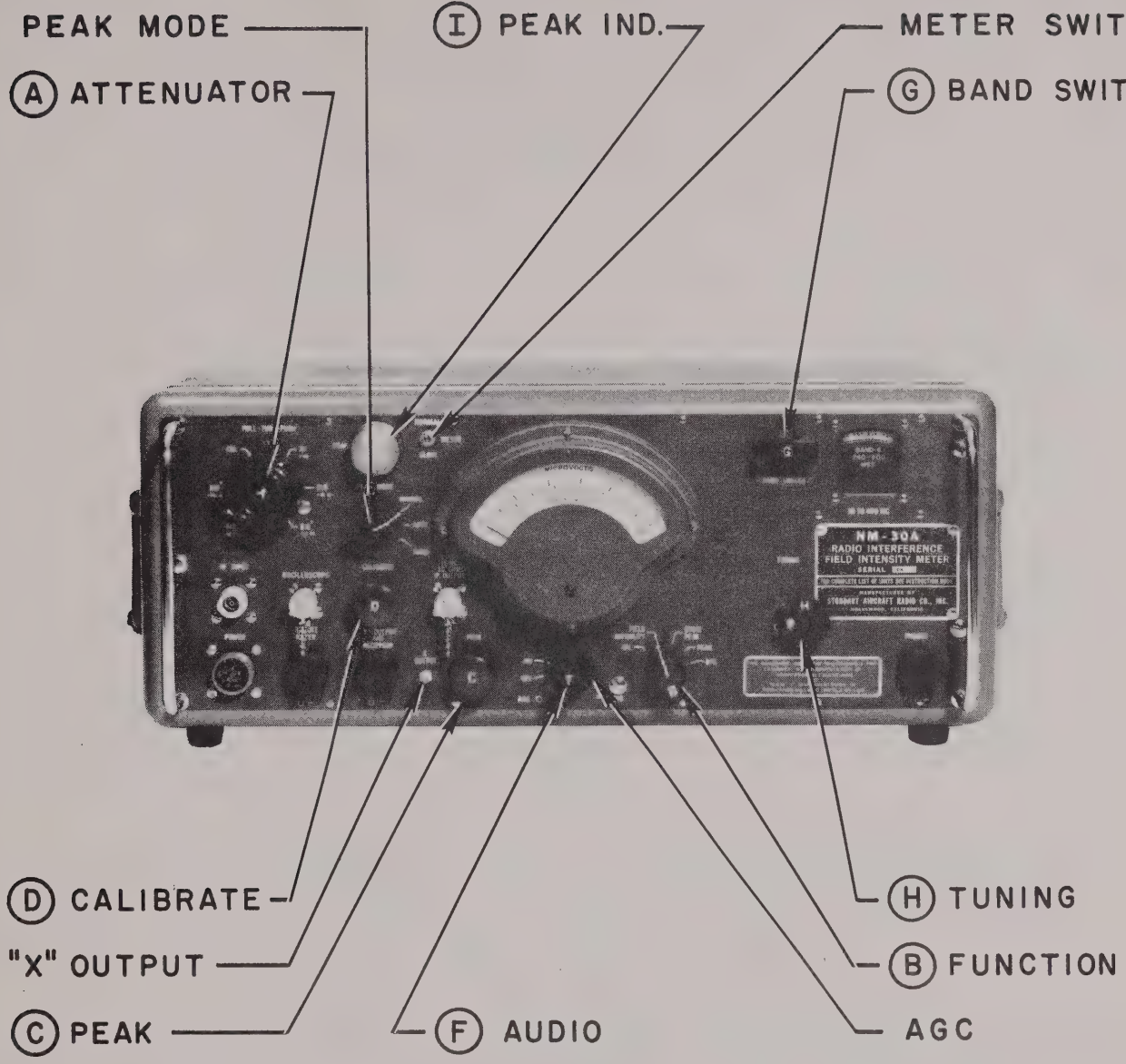


FIGURE 1-10. NM - 30A FRONT PANEL CONTROLS

SECTION II

THEORY OF OPERATION

2.1 INTRODUCTION

The following paragraphs describe the theory of operation of the NM-30A RI-FI Meter. The block diagram is shown in Figure 2-1. The 91923-2 Power Supply is discussed in Appendix A at the rear of this instruction book.

2.1.1 RF Input Devices. - Input devices for the NM-30A equipment include high and low frequency dipole antennas, a loop probe antenna, and a vertical ground plane antenna.

The high-frequency dipole antenna is used with bands 4, 5, and 6 (88 to 400 megacycles). The low frequency dipole antenna is used with bands 1, 2, and 3 (20 to 88 megacycles). Both dipoles can be tuned to resonance at any frequency within their respective bands. The dipole antennas have self-contained baluns to transform the balanced dipole output into an unbalanced output suitable for loading with a 50-ohm coaxial transmission line. Meter indications obtained when employing the dipole antennas must be modified by a pickup factor as determined from the calibration charts.

The loop probe antenna is used within the entire frequency range of the equipment (20 to 400 megacycles). It is rubber coated for probing near uninsulated conductors. Although a calibration chart is supplied for the loop probe antenna, these factors should be considered as only approximate; its use, therefore, is generally limited to relative measurements.

The ground plane vertical antenna is an omnidirectional antenna which can be used over the entire frequency range of the equipment. The antenna consists of telescopic sections and should be extended to the length indicated on the tape measure for the desired frequency.

2.1.2 Radio Interference-Field Intensity Meter. - The RI-FI Meter indicating meter scale is directly calibrated for a two-decade, approximately logarithmic, range of 1 to 100 microvolts (top scale) and an approximately linear 0 to 40 db (bottom scale) range.

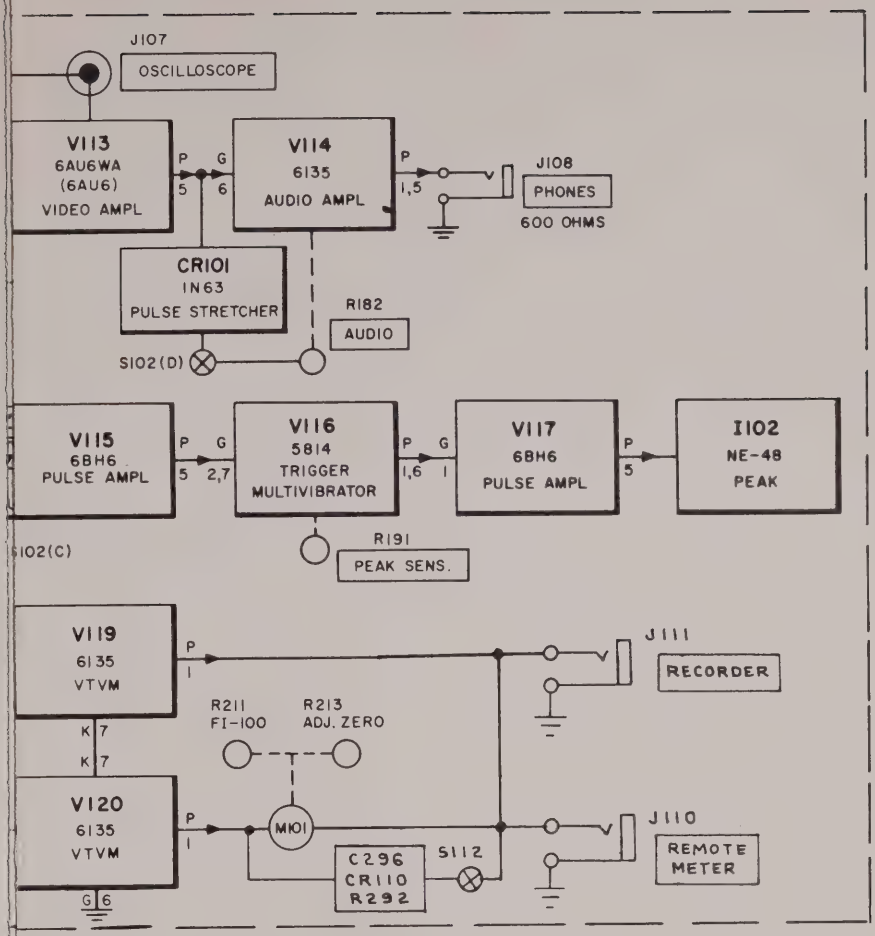
2.1.3 Signal Channel in the RI-FI Meter. - The signal channel closely resembles that of a superheterodyne radio receiver in its RF, IF, and AF circuits, but differs from most superheterodyne receivers in its provision for RF attenuation and detector output measurement.

The RF signal or interference (hereafter called signal) picked up by the antenna is delivered to the RF INPUT receptacle. The RF signal passes through the RF stage, and is mixed with the local oscillator frequency in the mixer stage to produce an intermediate frequency of 15 megacycles. The intermediate frequency is the same as the BFO crystal frequency so that a weak signal may be tuned to a null (or near null to produce an audible note). The strength of the signal can then be accurately measured with the function switch in the FIELD INTENSITY or QUASI-PEAK position. The IF signal is amplified in five IF stages and demodulated in the detector stage. The demodulated signal is modified by the meter detector weighting circuits and applied to the VTVM stage, actuating the meter. The audio components of the signal are subsequently amplified and delivered to the PHONES jack.

The internal calibrator supplies an impulsive calibrating voltage that follows the same signal path from the input of the RF stage to the indicating meter. With the impulse calibrator turned on (function and attenuator switches in CAL position), the gain of the IF section can be adjusted.

The built-in step attenuator provides the following step ratios: 1, 10, 100, 1000, and 10,000. The attenuation is obtained in the input of the RF and IF stages. The attenuation steps are listed as follows:

ATTENUATOR SETTING	ATTENUATION IN DB RF	IF
CAL	0	20
X1 +0 DB	0	0
X10 +20 DB	0	20
$X10^2$ +40 DB	20	20
$X10^3$ +60 DB	40	20
$X10^4$ +80 DB	60	20


J107
OSCILLOSCOPE
V113
6AU6WA
(6AU6)
VIDEO AMPL
P
G
5
6
V114
6135
AUDIO AMPL
P
1,5
J108
PHONES
600 OHMS
CR101
IN63
PULSE STRETCHER
R182
AUDIO
S102(D)
V115
6BH6
PULSE AMPL
P
G
5
2,7
V116
5814
TRIGGER
MULTIVIBRATOR
P
G
1,6
1
V117
6BH6
PULSE AMPL
P
5
I102
NE-48
PEAK
S102(C)
R191
PEAK SENS.
V119
6135
VTVM
P
1
J111
RECORDER
R211
FI-100
R213
ADJ. ZERO
K
7
K
7
V120
6135
VTVM
P
1
M101
C296
CR110
R292
S112
J110
REMOTE
METER
G
6

The RF signal or interference (hereafter called signal) picked up by the antenna is delivered to the RF INPUT receptacle. The RF signal passes through the RF stage, and is mixed with the local oscillator frequency in the mixer stage to produce an intermediate frequency of 15 megacycles. The intermediate frequency is the same as the BFO crystal frequency so that a weak signal may be tuned to a null (or near null to produce an audible note). The strength of the signal can then be accurately measured with the function switch in the FIELD INTENSITY or QUASI-PEAK position. The IF signal is amplified in five IF stages and demodulated in the detector stage. The demodulated signal is modified by the meter detector weighting circuits and applied to the VTVM stage, actuating the meter. The audio components of the signal are subsequently amplified and delivered to the PHONES jack.

The internal calibrator supplies an impulsive calibrating voltage that follows the same signal path from the input of the RF stage to the indicating meter. With the impulse calibrator turned on (function and attenuator switches in CAL position), the gain of the IF section can be adjusted.

The built-in step attenuator provides the following step ratios: 1, 10, 100, 1000, and 10,000. The attenuation is obtained in the input of the RF and IF stages. The attenuation steps are listed as follows:

ATTENUATOR SETTING	ATTENUATION IN DB RF	IF
CAL	0	20
X1 +0 DB	0	0
X10 +20 DB	0	20
$X10^2$ +40 DB	20	20
$X10^3$ +60 DB	40	20
$X10^4$ +80 DB	60	20

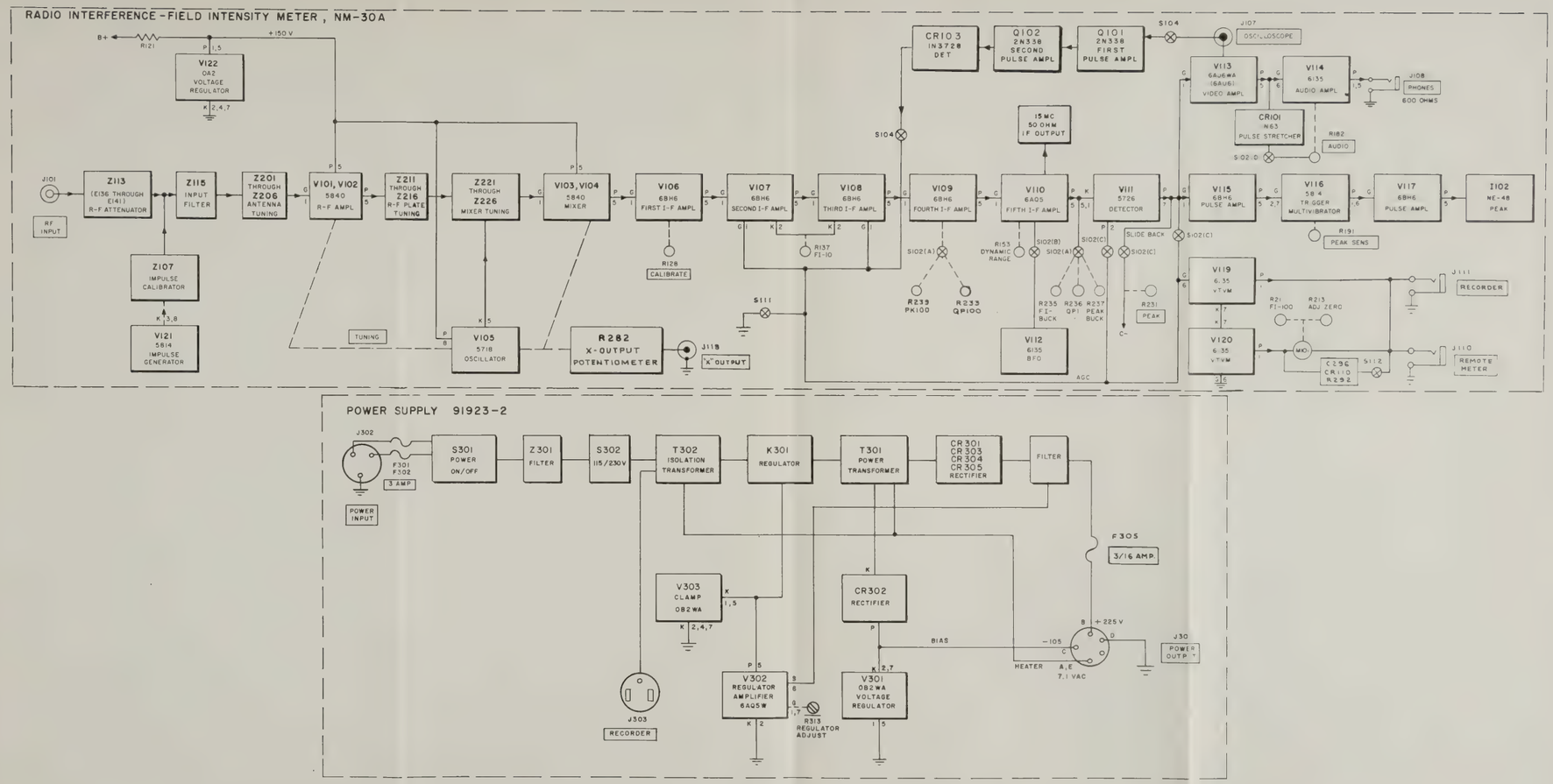


FIGURE 2-1. RADIO INTERFERENCE FIELD INTENSITY MEASURING EQUIPMENT- OVERALL BLOCK DIAGRAM

2.2 CIRCUIT ANALYSIS OF RI-FI METER

2.2.1 RF Attenuator and Input Circuits. - The RF attenuator Z113 consists of six cylinders (E136 through E141) mounted in a turret arrangement around a shaft which is extended to the front panel and labeled PULL-TURN-PUSH. This shaft imparts both rotational and linear motion to the assembly. Of the six cylinders, three contain T-section resistive networks, two are "straight-through" sections for zero attenuation, and one provides for the injection of a calibrating signal generated within the unit. Selection of each step of attenuation is accomplished by means of the PULL-TURN-PUSH control. Smooth, positive positioning is accomplished by a spring-loaded detent. The resistive elements sealed within the cylinders are precision one-watt resistors consisting of thin metallic films on ceramic discs.

The input signal from the antenna or pickup device is fed to the RF INPUT jack J101 (part of coupling section Z114) and then via J104 (also part of Z114) through cable W101 and its associated connectors P110 and P101 to the signal input connector J102 of the RF attenuator. At this point, the input signal passes through the selected attenuator (E137 through E141) to the coaxial switch S101 on the rear of the assembly.

In all positions of the attenuator control except CAL, switch S101 is closed to deliver the input signal to the RF stage via coaxial connectors J112 and P102.

In the CAL and X1 positions, two pins on the attenuator turret assembly actuate switch S103. This opens the normally closed switch and de-energizes relay K101 in the first IF amplifier stage. This removes the IF attenuation. In all other positions, S103 is not actuated.

In the CAL position, another pin on the attenuator turret assembly actuates coaxial switch S101 to connect J112 and J113. This permits the calibrating signal from the impulse generator Z107 to be injected into the RF stage for calibrating purposes.

2.2.2 Input Filter. - The input filter Z115 is a transmission line low-pass filter for attenuating frequencies above the tuning range of the RI-FI Meter. This filter uses sections of coaxial line having a high impedance with respect to the 50-ohm input as inductive elements, and sections of coaxial line having a low impedance with respect to 50 ohms as capacitive elements. Six constant-K sections are used, including matching input and output sections. The nominal cutoff frequency of this filter is 470 megacycles.

2.2.3 RF Stages. - In the following paragraphs, the description of system operation will be made for one of the six combinations of tuning elements only (band 1). Operation in the remaining five bands is identical in all cases.

The RF stages consist of the push-pull RF amplifier V101 and V102, local oscillator V105, and the push-pull mixer V103 and V104. The tuned circuits for these stages consists of a tuning capacitor and a turret assembly of six transformer and trimmer capacitor combinations. One combination is used for each band. The tuning capacitors are ganged and are driven by the TUNING control (H). Each tuned circuit is contained within a shielded compartment of the RF head. The turret assemblies are also ganged and are driven by the BANDSWITCH (G).

2.2.4 RF Amplifier Stage. - The RF signal from S101 of the attenuator assembly is applied through P102 to the primary winding of T101. The secondary of this transformer is tuned by C108 and C101 is the associated trimmer. The RF signal is applied directly to the grids of V101 and V102. These grids are biased negatively from the -105 volt supply by means of the voltage divider composed of R109 and R108 and through the grid resistors R102, R103, and R104. The amplified output taken from the plates of V101 and V102 is applied to the tuned output circuit C119, T111, and C121. The output from T111 is coupled by means of a low impedance link to the succeeding mixer stage.

2.2.5 Local Oscillator Stage. - The local oscillator stage consists primarily of triode V105, transformer T131, tuning capacitor C158, and trimmer C161 arranged in a modified Colpitts circuit. The oscillator output is always 15 megacycles higher than the signal frequency. Grid bias is developed across resistor R124. The oscillator output signal is fed from the cathode circuit to the mixer stage.

2.2.6 Mixer Stage. - The mixer stage consists primarily of mixer tubes V103 and V104, input transformer T121, tuning capacitor C137, trimmer C131, and output coupling transformer T150. Input signals from the RF amplifier stage and from the local oscillator stage are applied separately at low impedance levels to the two primary windings of T121. Simultaneous signals are applied in push-pull to the grids of V103 and V104. The intermediate frequency signal output of these tubes is taken from the plates and applied to the primary of the output coupling transformer T150. This transformer is tuned to the IF frequency of 15 megacycles. The low impedance output of the secondary winding of T150 is delivered through connector P103 to the IF amplifier stages.

2.2.7 Voltage Regulator Stage. - The plates of V101 through V105 must be energized from a well-regulated voltage supply in order to maintain stable operation. This regulated supply (+150 volts) is obtained from the +225 volt system supply by means of the voltage regulator V122 and series resistor R121. Capacitor C178 provides additional filtering of the regulated supply voltage.

2.2.8 IF Amplifier and Detector Stages. -

2.2.9 General. - The IF amplifier and detector stages consist of five IF amplifiers V106 through V110, a second detector V111, and a BFO, V112, mounted on the same chassis. The IF amplifier circuits are all tuned to 15 megacycles. Permeability-tuned transformer coupling is employed between all stages. The plate and heater voltage supplies of each stage are filtered and provided with decoupling networks to reduce the common impedance between stages. In this manner, feedback between stages is prevented. To provide attenuation, gain, and AGC features in the IF system, several of the IF stages are operated at different levels of tube operating bias. Compensation is required for the resulting Miller effect, which would be evidenced by a certain amount of detuning due to variation with signal strength of the capacitance across the tuned grid circuit. In the method used here, a partially unbypassed cathode resistance in combination with the capacitance from grid to cathode of a tube introduces feedback between the cathode and grid circuits. This, in effect, reduces the capacitance between grid and ground with increasing transconductance, and thereby compensates for the undesired detuning.

2.2.10 Input and First IF Amplifier Stage. - The IF signal from the RF stages is introduced at J105 and applied to the primary winding of transformer T151. The secondary of T151 is tuned to 15 megacycles by the series connected capacitors C183 and C182. In the X1 position of the RF attenuator, the output from the secondary of T151 is delivered to the grid of the first IF amplifier V106 through contacts 2, 4, 6, and 8 of the de-energized relay K101. In effect, no attenuation is introduced into either the RF or IF postions of the unit. For all other positions of the RF attenuator, relay K101 is energized and the grid of the first IF amplifier is fed from the tuned circuit of T151 (junction of capacitors C183 and C182) via contacts 5 and 6 of K101. Capacitors C183 and C182 form a capacitive divider to introduce an effective fixed attenuation of 20 db into the IF channel.

The first IF amplifier stage V106 functions primarily as a buffer stage and provides calibration control and input attenuation facilities rather than a high gain. The output is taken from the plate and coupled to the second IF amplifier V107 through transformer T152, which is tuned to 15 megacycles.

2.2.11 Second and Third IF Amplifier Stages. - The second and third IF amplifiers V107 and V108 constitutes AGC-controlled meter-scale tracking control stages. The circuits of both stages are functionally identical. Both circuits have unbypassed cathode resistors (R132 and R136, respectively). The grids of both tubes are supplied with AGC voltage through the secondary winding of the coupling transformer of the preceding stage. The operating bias for both tubes is controlled by the adjustment of the FI-10 potentiometer R137 which is used to establish correct meter scale tracking. A decoupling network composed of resistor R133 and capacitors C205 and C208 prevents detuning of transformer T153.

The output from the third IF amplifier stage V108 is coupled via T154 directly to the grid of the fourth IF amplifier V109.

2.2.12 Fourth and Fifth IF Amplifier Stages. - The fourth IF stage is an equalizing stage. The input from the third stage, V108, is applied directly to the grid of V109. The grid circuit of V109 is returned to ground through transformer T154. The cathode bias of V109 can be changed by means of the function switch S102 (A); appropriate values of bias are inserted so that the gain of the stage can be adjusted to provide the same output level from detector tube V111 for quasi-peak, field intensity, and peak operation. The output of V109 is coupled via T155 directly to the grid of IF stage V110.

The fifth IF stage V110 uses a power amplifier pentode in a high-gain circuit with high dynamic range (over load capacity). Resistor R149 provides cathode bias for this stage. The dynamic range of the stage is controlled by variable resistor R153 in the plate and screen circuits. The output of this stage is coupled via T156 to the cathodes of the detector stage V111.

2.2.13 Detector Stage. - The diode detector V111 demodulates the IF signal applied to its cathode from T156. One of the diodes delivers an output from the plate (pin 7) to two branch circuits. One branch output is applied through RF choke L106 to the pulse amplifier V115 and the video amplifier V113. The second branch output from the plate is applied to the AGC and VTVM circuits in the FIELD INTENSITY, CAL, and BFO positions of the function switch. Resistor R164 is the load resistor in this case.

The second section of the diode supplies an output from the plate (pin 2) across the load resistor R163 and is applied to the AGC and VTVM circuits only when the function switch is in the QUASI-PEAK position.

Both detector output circuits (pins 2 and 7) function normally when the AGC switch, S111, is in the ON position. When S111 is in the OFF position however, the AGC and VTVM circuits are rendered inoperative.

The oscilloscope output at J107 is taken directly from the plate (pin 7) of the detector, thus is a high-impedance point. Observe the CAUTION in Section I, para. 3.7, regarding connection to this output.

2.2.14 BFO Stage. - The BFO stage V112 permits detection of unmodulated CW signals. This stage consists of a crystal-controlled oscillator which operates at the 15 megacycle intermediate frequency. The impedance Z106, tuned to 15 megacycles, is in the plate supply line to increase the output signal. This oscillator is actuated only in the BFO position of the function switch S102. In this case, the AGC circuits are not active, the meter circuit is disconnected, and the equipment operates at maximum gain. The output from V112 is mixed with the IF signal from the fifth IF amplifier stage merely by leakage within the shielded compartment containing the BFO and second detector. The BFO is set into oscillation by the application of plate coltage via the BFO position of the function switch S102 (B). The BFO output signal frequency provides a convenient reference frequency for the alignment of the IF transformers T151 through T156.

2.2.15 Impulse Generator and Calibrator Stage. - The impulse generator drive (V121) and the calibrator Z107 constitute a standard calibrating signal source contained within the equipment. V121 is a free-running multivibrator operating at a low frequency (approximately 8 to 20 cps). V121 is energized via S102 (B) in the CAL position only. Capacitor C281 connected between the grid (pin 2) of V121 and the filament (pin 4) is used for tha application of an initial disturbance to the grid to start action of the multivibrator. V121 drives the impulse calibrator Z107 by means of the coils of Z107 which are connected in the cathode circuits of V121.

2.2.16 Pulse Amplifier and Visual Null Indicator Stage. - The pulse amplifier V115 is energized from the plate (pin 7) of detector V111 via RF choke L106 and capacitor C266. These signals can be either pulses or sine waves since they are derived from the same source as the video and audio signals used for oscilloscope and aural indication. The visual null indication, however, is provided primarily for use in peak value calibration where pulse signals are of interest. Accordingly, the pulse amplifier V115 and its circuits provide higher gain for pulse signals than for sine wave signals. The negative pulses arriving from the detector are amplified in V115 and the positive output pulses are coupled through T157 to the grid (pin 2) of V116A. Tube V116 is connected as a one-shot multivibrator trigger circuit.

Pulse amplifier V117 is held at cutoff by a large negative bias (-105 volts) in the BFO, QUASI-PEAK, and FIELD INTENSITY positions of the function switch S102 (B). Visual null indication is not used in these positions.

The trigger circuit of V116 is self-excited, or free-running, if a prescribed amount of bias is applied to the grid (pin 2) of V116A. In operation, with no signal applied to pin 2 of V116A, the PEAK SENS control R191 is adjusted to the point where V116 is free-running. At this point, the PEAK indicator lamp I102 starts to glow continuously. The PEAK SENS control R191 is then adjusted slightly in the opposite direction to the point where the PEAK indicator lamp I102 just ceases to glow. This is the threshold point where a slight increase in negative bias will cause V116 to trigger and produce one flash of I102 for each pulse input.

2.2.17 VTVM and Indicating Meter Stage. - The vacuum tube voltmeter circuit consists of a balanced bridge circuit in which triodes V119 and V120 form two adjacent arms. The dc voltage to be measured (from either of the two detector output circuits) is applied to the grid of V119. This upsets the balance of the bridge, causing the indicating meter M101 to deflect upscale and indicate the magnitude of the un-balance. The use of the balanced bridge circuit counteracts the effects of supply voltage variation since supply variations will affect both tubes equally, and the resulting change in meter indication will be negligible.

The VTVM circuit is rendered inoperative when the AGC switch, S111, is in the OFF position. This is accomplished by applying a ground to the grid (pin 6) of V119. The ADJ ZERO control R213 is used to adjust the voltage applied to the plates of V119 and V120 for balancing the bridge. Balance is indicated by a zero indication of meter M101 with no signal input present. The FI-100 control, R211, in series with meter M101, is a voltmeter sensitivity control for use in adjusting the meter full-scale deflection.

The METER switch, S112, permits the meter, remote meter, and/or recorder response time to be lengthened in the SLOW position. This is accomplished by placing a capacitor, C296, and diode, CR110, across the meter, M101, REMOTE METER receptacle, J110, and RECORDER receptacle, J111. In the NORMAL position of S112 this slow response circuit is discharged by R292 to prevent a charge building up across the capacitor from affecting the meter indication.

The REMOTE METER receptacle J110 and RECORDER receptacle J111 provide connection for a remote indicating meter and/or a milliammeter recorder or Y-axis of an X-Y plotter in series with meter M101. RF pickup by cables connected to these receptacles is filtered by capacitors C277 and C278.

2.2.18 Video and Audio Amplifier Stages. - The output of the detector V111 (pin 7) is applied through C259 to the video amplifier V113, where it is amplified and applied to the audio amplifier V114, and also to the input of the automatic peak circuit, C101. Video amplifier V113 has a wideband response so that the modulation envelope frequency components up to 100 kilocycles are passed. Low-frequency response is increased by the use of the unbypassed cathode resistor R177, and by capacitor C261.

The audio signal is taken from the plate of V113 and coupled via C262 to the AUDIO control R182. The audio signal is then applied through the function switch, S102D, to the grid of the audio amplifier, V114, where it is amplified and applied across T138 to the PHONES receptacle, J108.

In the CAL and PEAK positions of S102D a pulse stretching circuit is introduced into the audio line. This circuit consists of CR101 and C291, and is useful where the received signal is a series of pulses of such short duration and/or low repetition rate that the power output of V114 is not sufficient to drive the headphones.

The incoming positive pulse from video amplifier V113 passes through diode CR101 and charges C291. Because of the high resistance CR101 presents in the reverse direction, the charge of C291 leaks off slowly (with respect to the duration of the input pulse) through coupling capacitor C290 to the grid of audio amplifier V114. In this manner, the effective pulse length is increased and sufficient audio energy is produced to drive the headphones.

2.2.19 Function Switch, AGC, and Weighting Circuits. - The term "weighting" as used in this text refers to the time constant introduced in the detector and AGC circuits. This weighting effectively determines the time versus voltage characteristics of the indication obtained.

2.2.20 General. - The weighting circuits are selected by means of the function switch S102 and serve to properly weight the signal supplied to the indicating meter M101 for the three types of measurements performed by the equipment. These circuits and the performance features for each of the positions of the function switch S102 are discussed in the following sub-paragraphs.

2.2.21 Field Intensity Position. - In the FIELD INTENSITY position of function switch S102, only one half (pins 5 and 7) of detector V111 is used. Resistor R164 is the load resistor for this half of the detector V111. The video-audio signal is taken from the plate (pin 7) of V111 for application to pulse amplifier V115 and to video amplifier V113. Choke coil L106 and by-pass capacitor C254 constitute an IF filter to prevent appearance of an IF signal component in the audio-video line.

A small contact potential exists between the plate and cathode ov V111. If the secondary of T156 were connected to ground and no signal applied to the cathode, a small voltage would be developed across the plate load resistor R164. This voltage would also appear in the VTVM circuit and would cause a deflection on the indicating meter. To counteract this constant voltage a small positive voltage, derived from variable resistor R235, FI-BUCK, is applied through function switch S102 (A) and the secondary of T156 to the cathode (pin 5) of V111.

Variable resistor R235, FI-BUCK, is adjusted to just cancel the contact potential of V111. This control is normally set to produce a small deflection of the meter (approximately 1/16 inch deflection).

The detector output is also applied to the AGC circuit, R163 and C250, to produce the AGC signal which is applied to the grids of the second and third IF.

The time constant of the AGC circuit, R163 and C250, is 600 milliseconds for charging and discharging. This relatively slow charge and discharge time filters out most of the modulation present in the detector output and produces a dc voltage with a magnitude proportional to the average level of the original carrier. This same dc voltage is also applied to the VTVM tube V119 to actuate indicating meter M101.

Switch S102 (A) also connects the cathode of V109 to ground, thereby removing additional cathode bias. Switch S102 (B) applies a bias of -105 volts to the grid of pulse amplifier V117 to cut off this tube so that no visual indication can occur at PEAK indicator lamp I102. Switch S102 (D) connects the output of AUDIO control R182 directly to the grid of audio amplifier V114. Since pulse signals are not being studied in this position of the function switch, the pulse-stretching circuit is not necessary.

2.2.22 Quasi-Peak Position. - In the QUASI-PEAK position of S102, resistors R163 and R164 serve as the load resistors for the output from detector diode (pins 1 and 2). Resistors R163 and R164, capacitor C250, constitute the weighting circuit. When detector V111 conducts, capacitor C250 charges rapidly (one millisecond); when V111 ceases to conduct, capacitor C250 discharges slowly through R163 and R164, resulting in a long discharge time (600 milliseconds). Therefore, in the case of a received signal containing pulses occurring in rapid succession, the agerage voltage appearing across R163 and R164 will be near the peak value of the pulses. This voltage appearing across R163 and R164 is used as the AGC (and quasi-peak value) voltage which is applied to the grids of the second and third IF amplifier stages V107 and V108, and to the VTVM tube V119 to actuate indicating meter M101.

Because of this different mode of operation and the requirement that, for an unmodulated RF signal, the output indications must be the same for both FIELD INTENSITY and QUASI-PEAK operation, it is necessary that additional bias be applied to the fourth IF amplifier stage V109. This is accomplished by means of adjustable resistor R233, QP-100, in the cathode circuit of V109 via S102 (A).

The efficiency of detector V111 in the QUASI-PEAK operation differs from that in FIELD INTENSITY operation because of the difference in load resistors, and therefore, a different contact potential must be developed. Accordingly, a different positive bias is applied to the cathodes of V111 from R236, QP1, via S102 (A).

As in FIELD INTENSITY operation, pulse amplifier V117 is held cut off by S102 (B) and audio amplifier V114 is operated without the pulse-stretcher network by S102 (D).

2.2.23 Peak Position. - In the PEAK position of the function switch S102, the peak values of pulse signals are to be measured. In this case, one diode (pins 5 and 7) of detector V111 is used. Resistor R164 is the load resistor for the diode. Resistor R164, however, is no longer connected to ground as in the FIELD INTENSITY case, but is connected through S102 (C) and a filter network composed of capacitor C289 and resistor R230 to an adjustable negative bias control R231 PEAK. This provides the standard "slide-back" measurement facility for the determination of peak values.

Function switch S102 (A) permits application of a positive bias from variable resistor R237, Peak Buck, to the detector V111. This is done

to equalize the indicating meter reading for low signal levels (modulation of high repetition rate, i.e.; 1000 cps) in the PEAK position of function switch S102. S102 (A) also introduces an additional bias resistor in the cathode circuit of the fourth IF amplifier V109 to modify the gain of this stage in accordance with the PEAK operation. The PK-100 potentiometer, R239, adjusts the bias applied to V109 in the PEAK detector function. This is accomplished the same as the QP-100 function described in paragraph 2.2.22.

Switch S102 (C) connects the AGC circuit, R163 and C250 to the grids of the second and third IF amplifiers and to the VTVM stage. S102 (B) removes the cutoff bias from pulse amplifier V117 and applies the appropriate operating bias for this tube so that pulse signal indications can be observed. Since the PEAK function of this equipment is employed with pulse signals, the pulse stretcher circuit, CR101 and C291, is inserted in the input.

In operation, the slide-back PEAK control R231 is first set to produce the maximum negative bias; the control is then adjusted in the reverse direction until the PEAK indication lamp I102 just starts to flash, or until the signal is just heard in the headphones. At this point, the signals applied to detector V111 are just beginning to overcome the bias supplied by R231. This bias voltage is then the measurement of the peak voltage and is effective at the plate (pin 7) of V111, the AGC bias circuit, and the signal supplied to the VTVM tube V119. For this latter reason, the reading on indicating meter M101 is the measurement of the peak values.

2.2.24 BFO Position. - In the BFO position of the function switch, S102, the circuit connections are the same as for the FIELD INTENSITY position except as indicated in the following:

The AGC circuit is grounded through S102 (D). This causes the second and third IF amplifier stages V107 and V108, to operate at maximum gain. The VTVM tube, V119, is disabled. The fourth IF amplifier, V109, is also permitted to operate at maximum gain since its cathode is connected to ground via S102 (A). S102 (B) allows the application of +225 volts to the plate of the BFO tube, V112.

2.2.25 CAL Position. - The CAL position of the function switch, S102, provides the same circuit connections as in the PEAK position. This is done because the calibration of the equipment is accomplished by means of peak signals from the impulse calibrator, Z107. In addition to the PEAK position connections, the following connections are made.

Function switch S102 (B) provides for the application of +225 volts to the plates of the impulse generator drive, V121, so that the tube operates and actuates the impulse calibrator, Z107.

Function switch S102 (E) permits the application of either +105 volts or -105 volts to the impulse calibrator, Z107.

2.2.26 Peak Mode Switch. - When the function switch is in the PEAK position, the PEAK MODE switch, S104, permits selection of either a manual (slide-back) or automatic peak function. The switch has three positions; MANUAL, AUTO, and SCAN. In the MANUAL position normal peak "slide-back" operation is available as described in paragraph 2.2.23. In the AUTO or SCAN positions, the "slide-back" function is disabled and the automatic peak circuit is activated. In these positions, the visual peak amplifier, V117, is disabled and an automatic peak equalizing control, R256, is placed in the cathode bias circuit of V109.

2.2.27 Automatic Peak Circuit. - The automatic peak circuit consists of two pulse amplifiers, Q101 and Q102, and a peak detector, CR103. When the PEAK MODE switch is in either of the two automatic positions, the video output from V113 is applied to the first pulse amplifier, Q101.

The amplified output of Q102 is rectified by CR103 to form a negative going DC voltage and filtered by C297, R255, and C289. The negative going DC voltage is then applied to the grids of the two IF AGC amplifiers, V107 and V108, the VTVM stage, V119, and the plate of the IF detector, V111. The negative DC voltage is proportional to the magnitude of the applied radio-frequency signal, and is automatically indicated by the meter, M101. In the AUTO position of S104 an additional capacitor, C298, is inserted in the automatic peak detector filter circuit to increase the AGC hold time.

2.3 POWER SUPPLY

The power supply is discussed in Appendix A.

SECTION III

MAINTENANCE

3.0 INTRODUCTION

When the equipment has failed in operation, the source must be located, the defect remedied, and the equipment restored to operation. The information is presented in the following order:

Localization of Trouble

Removal of Chassis from Instrument Cases

Meter Unit Trouble Shooting and Repair

Power Supply Trouble Shooting and Repair (Appendix A)

Maintenance Procedures

An overall schematic, Figure 3-1, is provided at the end of this section. A table of electron tube operating voltages, Table 3-2, precedes the schematic.

3.1 LOCALIZATION OF TROUBLE

3.1.1 General. - Trouble shooting problems in the NM-30A equipment can be located just as troubles are located in communication receivers. Inspect the entire assembly in an attempt to isolate the faulty unit. Check the interconnecting cabling between units. Determine that the required power is applied to the power supply and that the operating potential outputs of the power supply are applied to the RI-FI Meter. The power supply indicator lamp I301 and the RI-FI Meter dial light I101 serve to indicate power application to the respective units. Determine whether or not an output indication can be obtained on the remote meter. Check that panel operating cotrols are employed properly as described in Section I, Operation.

If one of the RF input devices is the source of trouble, check the continuity of the circuit through the suspected device.

When apparent lack of operating potential output from the power supply is noted, check by making voltage measurements at the output connector of the power supply. This check must be made with the RI-FI Meter loading the power supply because of an interlocking feature in the B+ circuit.

In the event malfunctioning of the equipment is caused by the RFI Meter, continue the elimination procedure to locate the faulty stage. The RFI Meter is similar to a communication receiver, having an RF section, IF section, and AF section. In addition, it has a calibrator circuit, VTVM circuit, attenuator circuits, detector weighting circuits, and a pulse amplifier and visual null indicator circuit.

One major source of improper equipment operation is incorrect calibration and alignment control adjustment. Operational tests are contained in this section to aid in determining the efficiency of equipment operation. Complete calibration and alignment procedures are also given to aid in bringing the equipment up to highest sensitivity and accurate calibration.

3.1.2 Removal of Chassis from Instrument Cases. - To open the RFI Meter, stand the unit on its front panel guards. Loosen the two dzus fasteners on the back of the instrument case and slide the case off the chassis.

The IF section chassis of the RFI Meter can be removed from the main chassis section. Disengage the cable strap holding the cable associated with P104. Detach the AGC and function switch shaft couplings ahead of the main vertical chassis. Detach the audio shaft at the coupling of the audio pot located within the deck switch assembly at the rear of the vertical chassis. Allen wrenches for detachment are mounted on top of the RF shield cover. Note the position of the function switch for reassembly purposes. Loosen the two dzus fasteners, one on each end of the chassis, and remove the two screws located at the rear of the RF attenuator. The IF chassis can then be removed for inspection, trouble shooting, etc.

The units are reassembled in the reverse sequency as that given for removal.

3.2 OPERATIONAL TESTS

When localizing procedures indicate a fault in the RFI Meter, the source can readily be traced to any given stage. The calibrating circuit of V121 constitutes a convenient signal generator for checking receiver operation, assuming that it is operating satisfactorily. Turn the function switch, S102, and the PULL-TURN-PUSH attenuator control to the CAL position. This results in the application of plate voltage to the calibrator circuit and consequent injection of an impulse noise signal at the receiver input. If the RF, IF, and detector circuits are functioning, an audible pulse signal will be heard in the headphones with the PEAK control (c) completely counterclockwise and the CAL control (d) completely clockwise. To check the visual null indicator circuit, proceed as follows:

Rotate the PEAK control (c) to its maximum clockwise position. Rotate the internal PEAK SENS control, R191, clockwise until PEAK indicator

lamp I102 lights. Rotate the PEAK SENS control counterclockwise until the indicator lamp just ceases to light.

Check the audio and video sections by setting the function switch (b) to the FIELD INTENSITY position, tune the receiver to a signal, then adjust the AUDIO control (f) for a comfortable audio volume level in the headphones.

3.3 TROUBLE SHOOTING AND REPAIR

3.3.1 Shielding. - To meet the shielding requirements for the high frequencies employed in this equipment, the RF and IF stages are enclosed in shielded compartments.

3.3.2 Tube Changes. - The tube types used in this equipment design were chosen for their long life, ruggedness and reliability features. If the equipment fails and it is necessary to check the tubes each tube should be returned to its original socket or realignment of the equipment may be necessary. Tube testing is required only when malfunctioning of the equipment occurs and preventive maintenance such as periodic tube replacement is not recommended.

The miniature tubes in this equipment are held in place by spring-loaded tube shields. To remove, depress and turn the tube shield counterclockwise, then lift. To remove tubes, use the rubber tube extractor located on the right-hand gusset above the RF head.

Subminiature tubes are located within the RF head and can be removed, if necessary, for replacement. Disengage the cable strap holding the function switch shaft couplings by means of the Allen wrenches mounted on top of the RF head shield cover. Note the position of the function switch for replacement purposes. Loosen the two dzus fasteners, one at each end of the chassis and remove the two screws located at the rear of the attenuator. Remove the IF chassis and the RF head shield cover for access to the subminiature tubes. The tubes are held in place by cylindrical silver-plated bronze shields which are attached to tube shield plates. The tube shield plates are used to conduct and dissipate the heat emitted from the tubes.

Each tube shield plate is held to the adjustment compartment shield by means of a captive knurled nut. Loosen the knurled nut. Slide out the shield assembly in a direction away from the tube socket. The tube should remain in the shield during the operation. The tube can be removed from the shield by gently pushing the tube out, using a pencil eraser against the end opposite the pins. If the tube shield plate does not remove the tubes the tube extractor can be used. The new tube is inserted in the socket and the shield plate with spring shield placed over the tube. Be sure that the replaced tube

shield makes contact with the two spring clips located adjacent to the socket. Should any of the following tubes be replaced, the associated control circuits may be affected:

3. 3. 2. 1 Tube V106 influences the X10 position of the attenuator and also the tuning of T151 and T152. In the event of replacement, repeat the alignment procedure of paragraph 3. 7.

3. 3. 2. 2 Tubes V107 and V108 influence the output meter scale tracking and also the tuning of T152, T153 and T154. In event of replacement repeat the alignment procedure in paragraphs 3. 7. 3. 2 and 3. 7. 4. 2 and check 3. 7. 4. 3.

3. 3. 2. 3 Tube V109 controls the gain equalization between the FIELD INTENSITY and QUASI-PEAK positions of the function switch and also tuning of T154 and T155. If replacement of this tube is necessary, review the alignment procedure of paragraphs 3. 7. 3. 2 and 3. 7. 4. 3.

3. 3. 2. 4 Replacement of V110 may affect the dynamic range of the equipment and the tuning of T155 and T156. Repeat the alignment procedure of paragraphs 3. 7. 3. 2 and 3. 7. 4. 3. In removing the tube shield on V110, observe the aluminum washer placed between the top of the tube and the tube shield. This washer is required to maintain a fixed capacity between the tube shield and the tube elements. Place the washer over V110 before putting the tube shield in place. In the event the washer has been lost, obtain a replacement with the following dimensions: 51/64 OD x . 161 ID x 1/32 inch thick.

3. 3. 2. 5 The output meter scale tracking in the lower portion of the scale and the tuning of T156 can be affected by a replacement of tube V111. This can occur in all positions of the function switch except BFO position. In event of replacement, repeat the alignment procedure of paragraphs 3. 7. 3. 2, 3. 7. 4. 2, 3. 7. 4. 3 and 3. 7. 2. 4.

3. 3. 2. 6 The AGC and meter zero circuits are affected if gas current occurs in tubes V119 and/or V120. This is often apparent with new tubes but the circuits should stabilize after 5 to 16 hours of operation. In the event of replacement of these tubes, review the alignment procedures of paragraphs 3. 7. 2. 1 and 3. 7. 2. 2. Be certain to replace all tube shields and to lock all tube clamps before closing the unit.

3. 3. 3 At periodic intervals of approximately 100 operating hours, operation of the impulse noise calibrator should be checked for constancy of output pulse amplitude. Variations in pulse amplitude are indicative of defective calibrator contacts and require corrective measures to prevent spurious signal measurements. Excessive pulse variations can be detected in the following manner:

1) Set up the equipment for normal operation and apply power; permit a suitable warmup period before proceeding.

2) Refer to Section I, paragraph 6.3 standardizing gain and accomplish Steps 1 through 5, inclusive and note the indicating meter reading in decibels after completing Step 5. Test frequency shall be 25 mcs.

3) Adjust the PEAK control counterclockwise until all pulses from the calibrator are just indicated on the lamp as a continuously blinking signal. Do not exceed this point.

4) Note the indicating meter reading in decibels.

5) Subtract the reading of Step 2 from the reading taken in Step 4. If the difference is less than one decibel, the calibrator is functioning normally. However, should the difference be of the order of two decibels or greater, dirty calibrator contacts are indicated and the following corrective procedures must be followed:

   (a) Remove the main chassis from the instrument case and detach the IF section chassis as outlined in paragraph 3.2 of this section.

   (b) Lay the IF section alongside the main chassis with the front panel side of the IF chassis facing uppermost and disconnect P106 from the calibrator output receptacle.

   (c) Loosen the two set screws holding the impulse calibrator output receptacle in the calibrator assembly with No. 6 Allen wrench (H135).

   (d) Utilizing a piece of 1/16 inch metal as a screwdriver, insert it into the slots in the end of the receptacle and loosen the receptacle body, then unscrew the connector body by hand.

(e) Lay a piece of clean, white bond paper on a flat surface and, holding the connector body vertical, burnish the contact on the inner end of the connector by sliding over the paper, utilizing a circular motion, until all blackened deposit on the contact is removed.

(f) Replace the connector body in the calibrator assembl and tighten with the improvised screwdriver; tighten the set screws.

(g) Connect P106 to the output receptacle of the calibrator.

(h) Apply power to the equipment and check operation of the calibrator. If operation is still unsatisfactory, remove power from the equipment and continue as follows:

(i) Turn the IF section on its side with the calibrator uppermost and unsolder the lead to the feed through capacitor input terminal of the calibrator.

(j) Unscrew the feed through capacitor from the input tube and draw it straight out of the tube; the charging resistor and contact will come away with the capacitor.

(k) Hold the charging contact as near the contact end as possible and burnish as outlined in Step (e) above. Be very careful not to bend or otherwise damage the contact and resistor assembly.

(l) Replace the assembly in the input tube and tighten the capacitor in place.

(m) Resolder the lead to the feed through capacitor and apply power to the equipment, checking operation of the unit. If operation is still unsatisfactory, remove power from the equipment and continue as follows:

(n) Turn the IF section over and detach P106 from the output receptacle of the calibrator.

(o) Remove the input receptacle as outlined in Steps (c) and (d) above and disconnect P103 from J105 and P104 from J103.

(p) Very carefully, turn the IF section chassis on its side and, holding a hand below the receptacle opening of the calibrator, shake the IF chassis until the center, movable contactor of the calibrator falls out of the calibrator into the hand.

CAUTION

Exercise extreme care in handling the contactor since the discharge contact is of extremely small diameter and is subject to considerable damage when mishandled.

(q) Holding the contactor with a light finger grip, burnish the larger of the two axially located contacts (charging contact) as outlined in Step (e) above.

(r) Then, very carefully, clean the side of the smaller discharge contact by scraping with the edge of a strip of clean white bond paper; do not burnish the contact point. If possible, inspect the small contace with a magnifying glass and remove all loose materials with the edge of the paper.

(s) With a pair of tweezers, return the contactor to its position within the calibrator; the larger contact must enter the opening first.

CAUTION

The contactor is a close tolerance fit within its insulating sleeve and must not be forced. If the contactor does not completely enter its sleeve, touching its outer edge will be sufficient to start its entry again.

(t) Replace the receptacle and secure as outlined in Step (f) above.

(u) Reconnect P106 to the calibrator receptacle, P104 to J103, and P103 to J105 and apply power to the equipment. Operation of the calibrator should now be satisfactory.

(v) Replace the IF section on the main chassis as outlined in paragraph 3. 2 of this section; then, replace the main chassis in the instrument as instructed in the same paragraph.

3. 4 Replacement of Parts. - Defective parts should be replaced with correct replacement parts as listed in Section 4. Upon removing the defective part, install the replacement part in the exact position of the original part. Keep the leads on replacement parts in RF circuits the exact length of those on the original.

When coaxial connectors have been disconnected during maintenance procedures, securely tighten the connectors before placing the RI-FI Meter in service. This is extremely important in order to avoid discontinuity at the coaxial connector which adversely affects the standing wave ratio on the coaxial line.

3. 5 EQUIPMENT REQUIRED FOR ALIGNMENT AND ADJUSTMENT

3. 5. 1 NM-30A Components:

1) NM-30A RI-FI Meter.

2) 91923-2 Power Supply.

3) 91258-1 AC Power Cable.

4) 91487-1 Power Cable.

5) 90933-1 RF Transmission Line.

6) 20377 Alignment Tool. (located in RI-FI Meter)

3.5.2 Test and Miscellaneous Equipment:

1) Signal generator: HP608C or equivalent.

2) Vacuum-tube voltmeter: Measurements Corporation Model 62, or equivalent high-impedance-input meter.

3) 6-db, 50 ohm pad for output termination of the signal generator if required.

4) Coaxial cable patch cord comprising RG-58/U or RG-58/U cable with connector types UG-29/U and UG-201/U.

5) 10796 headphones, 600 ohms or equivalent.

6) Impulse Generator: Stoddart 91263-1 or equivalent.

7) 20-db, 50 ohm pad for output termination of the impulse generator.

3.6 SETUP OF EQUIPMENT

Before commencing alignment and adjustment of this equipment, check the mechanical zero setting of the front panel meter with equipment power off. It is possible that correcting this zero setting will correct the symptoms of misalignment or maladjustment and the equipment can be returned to service.

Step 1. Remove the RFI Meter from its case and set up on a bench or table.

Step 2. Interconnect the RFI Meter and the power supply by means of power cable 91487-1. Turn the POWER switch S301 to the OFF position.

Step 3. Connect the power supply to a source of 115 volts ac, preferably 60 cycles per second by means of the 91258-1 AC power cable. Ground the clip at the input end of this cable. Check that switch S302 located on the power supply chassis is set for 115 volts and that the metal reminder tag is on the front panel and set to indicate this condition.

3.7 ALIGNMENT AND ADJUSTMENT PROCEDURES

3.7.1 Preliminary Checks:

Turn the power supply POWER switch S301 to the ON position. Allow one hour warmup period before commencing alignment and adjustment procedures.

Then check the following voltages at the points indicated:

1) B+ (+225 volts): Check at the POWER receptacle J106, pin B, located on the RI-FI Meter.

2) Bias supply (-105 volts): Check at the POWER receptacle J106, pin C, located on the RI-FI Meter.

3) Filament supply (6.3 volts ac): Check at the POWER receptacle J106, pin A, located on the RI-FI Meter.

3.7.2 Preliminary Meter Tracking Adjustment. -

3.7.2.1 Adjustment of Electrical Zero:

Step 1. Set the function switch S102 to the BFO position.

Step 2. Set the ADJ. ZERO control R213 for a zero meter reading. All screwdriver controls contain a locking nut which must be loosened to allow adjustment of the control. The locking nut must be tightened after adjustment.

CAUTION

Be very careful when adjusting the six small potentiometers mounted on the printed board. These can be damaged when forced against the action of the locking nut or against the stops at the end of the control range.

3.7.2.2 Check for Gas Current. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	CAL
FUNCTION SWITCH	-	FIELD INTENSITY
TUNING dial frequency	-	Any
CALIBRATE	-	Fully counterclockwise

Step 2. Turn the FI-10 control R137 and the FI-BUCK control R235 to maximum counterclockwise positions. The

meter indication should not go below zero. If it does, gas current may be present in V119. New tubes invariably show some gas current, which almost always disappears after 5 to 16 hours of operation. If gas current indication is appreciable it should be corrected either by aging of V119 if the tube is new or replacement of V119 and aging before continuing the adjustment procedure. Gas current in tubes V107 and V108 can also cause meter indications to go below zero, though this occurs much less frequently than for V119.

Step 3. Adjust the meter zero as in sub-paragraph 3. 7. 2. 1 preceding.

3. 7. 2. 3 Preliminary Adjustment of FI-10 Control:

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	CAL
FUNCTION SWITCH	-	FIELD INTENSITY
TUNING dial frequency	-	Any
CALIBRATE	-	Fully counterclockwise

Step 2. Using the VTVM, connect the negative lead to the chassis (ground) and the positive lead to the arm of the FI-10 control R137. Adjust the FI-10 control for a VTVM indication of approximately 4. 0 volts dc.

3. 7. 2. 4 Preliminary Adjustment of Diode Bucking Voltages. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	CAL
FUNCTION SWITCH	-	FIELD INTENSITY
TUNING dial frequency	-	Any
CALIBRATE	-	Fully counterclockwise

Step 2. Adjust the FI-BUCK control to provide approximately 1% (1/16 inch) deflection of the panel indicating meter M101. Switch to QP and set QP-1 control for approximately the same deflection.

3.7.3 Intermediate-Frequency Alignment. -

3.7.3.1 Set Up of Equipment for IF Alignment. -

Step 1. Remove the IF amplifier chassis from the gusset plates (2 dzus fasteners, AUDIO and FUNCTION switch shaft couplings and RF attenuator screws).

Step 2. Disconnect P103 from J105.

Step 3. Connect the output of the signal generator to the IF amplifier input connector J105 using 90933-1 RF transmission line, coaxial cable patch cord and connectors.

Step 4. Plug headphones into PHONES receptacle J108.

Step 5. Energize the equipment.

3.7.3.2 Alignment of IF Transformers. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	X1
FUNCTION SWITCH	-	As called for
CALIBRATE	-	Fully clockwise
AUDIO	-	Adjust as required

Step 2. Adjust the signal generator frequency to the BFO frequency, modulation OFF. This can be done by setting the function switch to BFO and tuning the signal generator in the vacinity of 15 megacycles for a beat note as heard in the headphones.

Step 3. Turn the function switch to FIELD INTENSITY. Adjust the signal generator output and CALIBRATE control for an up-scale reading on the output meter M101.

Step 4. Using a 3/16 inch nut wrench, adjust the IF transformer T152 through T156 for maximum indication on M101, readjusting CALIBRATE control as needed to maintain an "on scale" reading.

3.7.4 Preliminary Meter Tracking Adjustments. -

3.7.4.1 Set up of Equipment for Meter Tracking Adjustments. -

Use set up described in IF alignment, paragraph 3.7.3 preceding.

3.7.4.2 Adjustment of the FI-10, FI-100 and FI-BUCK Controls. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	X1
FUNCTION SWITCH	-	FIELD INTENSITY
CALIBRATE	-	As called for

Step 2. With the signal generator still at the BFO frequency and with internal modulation OFF, adjust the output to a 50 microvolt level. Adjust the CALIBRATE control so that M101 indicates 1 microvolt.

Step 3. Increase the output of the signal generator to 5000 microvolts. Adjust FI-100 control R211 so that M101 reads full scale, 100 microvolts.

Step 4. Decrease the signal generator output to 50 microvolts and readjust the CALIBRATE control for a 1 microvolt reading.

Step 5. Repeat Steps 2 through 4 until both points fall into place without further adjustment.

Step 6. Set the signal generator output to 500 microvolts. M101 should indicate 10 microvolts. If not, adjust the FI-10 control R137 for M101 indication of 10 microvolts. If an error is one or more microvolts, move meter reading beyond 10 microvolts a few divisions. For example: If M101 indicates 13 microvolts instead of the correct value of 10,

adjust FI-10 control R137 for a meter reading of perhaps 8 microvolts, and vice versa. Then repeat Steps 1 through 6 until meter tracks 1-10-100 without further adjustment.

NOTE

Check adjustment of electrical zero occasionally, function switch at BFO position. Check adjustment of diode bucking voltage (refer to 3.7.2). This should be done occasionally. If the meter reads above 10 microvolts despite various settings of the FI-10 control use a diode bucking voltage of less than 1/16 inch but greater than zero, and repeat Steps 1 through 6. Should the reserve gain be low, a condition most pronounced in band 6, use a diode bucking voltage of less than 1/16 inch but greater than zero and repeat Steps 1 through 6.

3.7.4.3 Adjustment of Dynamic Range (Overload Capacity) Control. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	X1
FUNCTION SWITCH	-	FIELD INTENSITY
PEAK	-	As called for
CALIBRATE	-	As called for

Step 2. With power turned OFF, disconnect the wire that connects C200 and passes through the eyelet on the printed circuit board. Add a jumper from C200 to the junction C289 and R230.

Step 3 Connect a high-impedance vacuum-tube voltmeter between the chassis (positive) and C200 (negative). Turn the power ON and allow equipment to warm up. Adjust the PEAK control for 100-microvolt deflection of output meter M101. Note the voltage registered by the VTVM.

NOTE

If the voltage indicated by the VTVM exceeds 5.5 volts, difficulty may be experienced in adjusting for 20 db (±2db) dynamic range in Steps 5 and 6, following: This voltage level is established when adjusting FI-100 control R211 during meter scale tracking procedure. By allowing the "10 microvolt" point to fall a little low when the meter scale tracking is set (see paragraph 3.7), the above voltage will be decreased.

Step 4. Connect the VTVM between chassis (positive) and the junction of C254 and C266 (negative).

Step 5. Adjust the signal generator output to 1000 microvolts. Adjust the CALIBRATE control for same indication on VTVM as noted in Step 3.

Step 6. Increase the signal generator output by 20 db (10 times, or to 10,000 microvolts). The VTVM reading should be 9 times the original reading (10% down from linearity). Example: If at the start, 1000 microvolts input provided 4 volts output, then with 10,000 microvolts input, there should be 9 x 4 = 36 volts output. If the VTVM reading is other than 9 times, adjust the dynamic range control R153 clockwise if the reading is low, and counterclockwise if the reading is high. Repeat Steps 5 and 6 until no further adjustment is required.

Step 7. Remove the jumper from C200 to the junction of C289 and R230 and resolder the wire to C200.

Step 8. Tighten the lock nut on R153.

NOTE

The final adjustment procedures of T150, T151 and attenuator position X10 are given in paragraph 8.f. These final adjustments are performed after the RF alignment procedures.

3.7.5 RF Alignment. -

3.7.5.1 Set Up of Equipment for RF Alignment. -

Step 1. Set up the equipment as described in paragraph 7 of this section.

Step 2. Plug headphones into PHONES receptacle J108 on the RI-FI Meter front panel.

Step 3. Insert the coaxial cable patch cord and the 6 db, 50-ohm pad in series with the 90933-1 RF transmission line between the signal generator and the RI-FI Meter.

Step 4. Connect the signal generator to an external source of 110 volts, 60 cycles. Turn the signal generator power switch to its ON position.

NOTE

Frequency calibration of the signal generator should be checked with a suitable frequency meter prior to these alignment tests.

Step 5. Turn the power supply POWER switch S301 to its ON position and allow a reasonable time for both the signal generator and the RI-FI Meter to reach stable operating temperature before beginning these alignment procedures.

3.7.5.2 Position of Operating Control. -

ATTENUATOR	-	X1
TUNING dial frequency	-	As called for
BANDSWITCH	-	As called for
FUNCTION SWITCH	-	FIELD INTENSITY
CALIBRATE	-	As called for
AUDIO	-	Comfortable headphone level

3.7.5.3 Alignment of RF Circuits. -

(A) Low-Frequency End, Band 1:

Step 1. Set the TUNING dial for a frequency of 20 megacycles (low end of band 1) and readjust the CALIBRATE control for a reading of approximately 1 microvolt on the output meter M101.

Step 2. Adjust the signal generator for an unmodulated 20 megacycle signal at an output level sufficient to provide a useable deflection on the output meter.

Step 3. Adjust the tuning slug in the oscillator transformer T131 (part of Z231) for a maximum output reading on the meter.

CAUTION

Do not turn the tuning slugs more than one complete turn in either direction without being certain that the adjustment is being made in the right direction and that the screw will clear the shield cover when the coil turret is rotated.

Step 4. Adjust the tuning slugs in the transformers in the mixer grid circuit T121 (part of Z221), the RF amplifier plate circuit T111 (part of Z211), and the antenna circuit T101 (part of Z210) in the order given for maximum output indication.

Step 5. Recheck the adjustments of the transformer slugs of T131, T121, and T101 to be certain that maximum output is obtained.

(a) Repeat sub-paragraphs 3.7.5.3 preceding, 3.7.5.4 following, until no further adjustments are necessary.

(b) Bands 2 through 6: Bands 2 through 6 are aligned in the same manner as given previously for Band 1, with the proper settings of the low-end frequencies. Refer to Table 3-1 for the adjustment frequencies

and the circuit adjustments for all bands. The following notes apply to the alignment of band 6 only. The range of adjustments of the trimmer capacitor C166 and the inductance slug on the oscillator transformer T136 may be sufficient to place the oscillator frequency 15 megacycles below the signal frequency under certain conditions of adjustment. For example, the oscillator could be 15 megacycles above the signal frequency at the low end of band 6 and 15 megacycles below the signal frequency at the high end of band 6. This would cause mistracking over the band, with resultant poor sensitivity. If there is reason to believe that the oscillator is 15 megacycles below the signal frequency, the oscillator frequency should be checked with an instrument having a suitable frequency range such as a grid-dip meter or frequency meter. Another method of checking the oscillator frequency is to check the frequency of the IF image response, which should be 30 megacycles above the signal frequency in all cases. Alignment of the mixer grid circuit on the high end of band 6 (C136) may cause a slight shift in the oscillator frequency ("pulling") in some cases. The oscillator trimmer C166 should be reset, if necessary, after adjusting the mixer grid trimmer C136 and before adjusting the RF amplifier plate circuit trimmer C126.

3.7.5.4 (B) High-Frequency End, Band 1. -

Step 1. Set BANDSWITCH on band 1, set TUNING dial on 33 megacycles, and set the CALIBRATE control for a reading of approximately 1 on the microvolt scale of the meter M101.

Step 2. Adjust the signal generator for an unmodulated 33 megacycle signal output so that a useable scale reading (approximately half or three-quarters full scale) is obtained on meter M101.

Step 3. Adjust the oscillator trimmer capacitor C161 (part of Z231) for maximum deflection of the output meter.

(It may be necessary to readjust the signal generator output level to keep the output meter reading less than full scale.)

CAUTION

Do not turn the trimmer slugs more than one complete turn in either direction without being certain that the adjustment is being made in the right direction and that the screw will clear the shield cover when the coil turret is rotated.

Step 4. Adjust the mixer trimmer capacitor C131 (part of Z221) for maximum output on meter M101.

Step 5. Adjust the RF amplifier plate circuit trimmer capacitor C121 (part ofZ211) for maximum deflection of the output meter.

Step 6. Adjust the antenna circuit trimmer capacitor C101 (part of Z201) for maximum meter deflection.

Step 7. Recheck the adjustment of trimmer capacitors C161, C131, C121, C101 to be certain that all circuits are peaked for maximum output.

TABLE 3-1, RF ALIGNMENT CHART (Bands 1 thru 6)

BAND NO.	HIGH END Signal Frequency (mc)	LOW END Signal Frequency (mc)
1	33. 0	20. 0
2	54. 0	33. 0
3	88. 0	54. 0
4	145. 0	88. 0
5	240. 0	145. 0
6	400. 0	240. 0

NOTES:

1) The oscillator frequency is 15 megacycles above the signal frequency in all bands.

2) Trimmer (high end) and slug (low end) adjustments are made through small access holes in the rear of the RF shield cover with the BANDSWITCH set on the given position.

3) Trimmer capacitor adjustment screws are located in the bottom position (nearest variable tuning capacitor) and inductance slug adjustment screws are in top position (nearest to turret shaft) of the RF shield cover with the RI-FI Meter in its normal position.

4) Repeat adjustments until no further tuning is required.

3.7.6 Adjustment of T150, T151, and Attenuator Step X10:

It is assumed in this sub-paragraph that the RF alignment is satisfactory:

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	-	As called for
FUNCTION SWITCH	-	FIELD INTENSITY
CALIBRATE	-	As called for
TUNING dial frequency	-	As called for

Step 2. Set up the equipment as indicated for paragraph 3.6. Connect the signal generator to J101 using the 90933-1 RF transmission line.

Step 3. Tune the signal generator to 20 megacycles and adjust the output to 100 microvolts. Set the attenuator to its X1 position. Tune the RF head for maximum response to the 20 megacycle signal and adjust the CALIBRATE control for an up-scale indication on output meter M101.

Step 4. Tune transformer T150 with the alignment tool and transformer T151 with a 3/16 inch nut wrench for maximum indication on M101, readjust the CALIBRATE control as needed to maintain an on-scale reading.

Step 5. Set the attenuator to its X10 position. Tune C181 with the alignment tool for maximum response on M101. Repeat Steps 3 through 5 until no further adjustment is necessary.

Step 6. Change the attenuator setting back to the X1 position. Adjust the CALIBRATE control for an output meter indication of 100 microvolts. Switch the attenuator to its X10 position. Then increase the signal generator output by 10 times (20db) or to 1000 microvolts. Output meter M101 indication should again be 100 microvolts. If attenuator step X10 does not provide this 20 db attenuation, change the setting of C182 (increase capacitance for less attenuation and decrease capacitance for greater attenuation) and repeat Steps 3 through 6. Repeat as often as required to achieve 20 db of attenuation between X1 and X10 attenuator steps.

3.7.7 Final FI and CP Adjustments. -

Make the final FI and CP adjustments at 20 megacycles with the attenuator in the X10 position, with the signal generator output set at 10 and 1000 microvolts.

3.7.8 Adjustment of Peak Tracking Controls. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR (A)	- X10
Function Switch (B)	- As called for
PEAK MODE switch	- MANUAL
PEAK (C)	- For full scale indication on M101
CALIBRATE (D)	- Full counterclockwise

Step 2. Set the function switch to the PEAK position. Adjust the "peak sensitivity" potentiometer, R191, until the PEAK indicator flashes, then back off 1/2 turn past the point where the indicator just ceases to flash.

Step 3. Adjust the PK-100 potentiometer, R239, to the mid-range position and set the function switch to the FIELD INTENSITY position. Tune the RFI Meter and signal generator to 20 megacycles.

Step 4. Adjust the signal generator output to 100 microvolts (unmodulated) and adjust the CALIBRATE control for a 10 microvolt indication on M101.

Step 5. Set the function switch to the PEAK position and adjust the PEAK control to obtain a 10 microvolt indication on M101: Adjust the "peak bucking" potentiometer, R237, until the PEAK indicator flashes, then back off until it just ceases to flash.

Step 6. Reduce the signal generator output to 10 microvolts and adjust the PEAK control until the PEAK indicator just starts to flash: This should be at approximately 1.5 db on M101.

NOTE

If the PEAK indicator flashes higher than 1.5 db the PK-100 potentiometer, R239, is set too "high" and must be re-adjusted in a counterclockwise direction. If the indicator flashes much below 1.5 db the PK-100 potentiometer must be re-adjusted in a clockwise direction. If adjustments are necessary repeat Steps 4, 5, and 6.

Step 7. Increase the signal generator output to 800 microvolts and adjust the PEAK control until the PEAK indicator just ceases to flash: This should occur at 38 db (80 microvolts) on M101, $\pm$ 0.25 db.

NOTE

Check the PEAK reference with the FIELD INTENSITY reference.

Step 8. Reduce the signal generator output to 100 microvolts and adjust the CALIBRATE control to obtain a 10 microvolt indication on M101.

Step 9. Set the function switch to the PEAK position and adjust the PEAK control for a 10 microvolt indication on M101: The PEAK indicator should flash just as the needle crosses the 10 microvolt threshold. Set the control for 10 microvolts on M101.

Step 10. Remove the 90933-1 RF cable from the signal generator and connect through a 50-ohm, 6 or 10 db pad, to the output of the 91263-1 Impulse Generator. Adjust the impulse generator output level until the PEAK indicator just ceases to flash at the 10 microvolt mark.

NOTE

The 50-ohm pad should be of a non-inductive type.

Step 11. Reduce the impulse generator output by 20 db and adjust the PEAK control until the PEAK indicator just flashes: This should occur at the 1 microvolt indication on M101, ± 0.25 db, if the tracking adjustments are correct.

Step 12. Increase the impulse generator output by 38 db and adjust the PEAK control until the PEAK indicator just ceases to flash: This should occur at the 38 db (80 microvolt) indication on M101, ± 0.25 db.

NOTE

If tracking is not within ± 0.25 db, repeat Steps 4 through 12 until proper tracking is obtained.

3.8 CORRECTING CHART SET AFTER ALIGNMENT

3.8.1 General. -

Data plotted on all charts of the chart set have been plotted for the individual equipment as shipped. Upon completing the maintenance procedures described in paragraph 3.7, it is necessary to obtain new data and plot these charts accordingly. The original plot can be erased and new curves drawn in with pencil or draftsman's pen. If the overall bandpass of the equipment is the same as before and an accurate signal generator is used, it is possible that the original data will be closely repeated and redrawing of the charts thus becomes unnecessary.

After the RFI Meter has been aligned in accordance with the instructions of paragraph 3.7, obtain data for the chart set at each of the following calibrating frequencies:

BAND	FREQUENCIES				
1	20,	23,	26,	29,	33
2	33,	37,	42,	48,	54
3	54,	62,	70,	80,	88
4	88,	100,	115,	130,	145
5	145,	170,	195,	220,	240
6	240,	280,	320,	360,	400

3.8.2 Calibrating Procedure. -

Charts 6 and 7 (Random Noise Bandwidth):

The overall bandwidth of the RFI Meter is influenced by the selectivity of the RF tuned circuits; therefore, bandwidth data must be taken at radio frequencies listed immediately preceding.

A signal generator is ordinarily used for measuring bandwidth. This method is suitable for the low end of the frequency range but becomes too critical at the higher frequencies. At the higher frequencies the internal impulse noise calibrator will be used in determining bandwidth. Advantage will be taken of its constant output per unit bandwidth and the fact that the meter reading obtained is directly proportional to bandwidth. By dividing the calibrator output by the bandwidth at a low frequency a factor is derived which can be used at other frequencies. The accuracy of measuring bandwidth by the following procedure depends on the accuracy of the signal generator output.

3.8.2.1 Random Noise Bandwidth Measurement. -

Step 1. Set up the following operating controls as indicated:

ATTENUATOR	- X1
FUNCTION SWITCH	- FIELD INTENSITY
CALIBRATE	- As called for

Step 2. Connect the output of the signal generator to J101 using the 90933-1 RF transmission line.

Step 3. Adjust the signal generator frequency to 20 megacycles. Adjust output to 100 microvolt.

Step 4. Tune the RFI Meter for maximum response to the test signal. Adjust the CALIBRATE control for M101 indication of 50 microvolts.

Step 5. Increase the signal generator output by exactly 6 db (2 times).

Step 6. Decrease the signal generator frequency to above 18 megacycles, then slowly increase the frequency beyond 20 megacycles. Observe the two signal generator frequencies at which M101 indicates 50 microvolts. Record the difference in frequency between the two observed points: This is the overall 6 eb bandwidth at this test frequency. In order to counteract backlash in the signal generator tuning mechanism, always sweep the signal generator frequency continuously in one direction from a point below the calibrating frequency upward to a point above the calibrating frequency. The two frequencies will be quite close together so use the vernier markings on the signal generator tuning knob for accurate readings.

Step 7. Standardize the gain as per instructions on first page of chart set at test frequency of 20 mcs but instead of using the calibrator setting provided on Chart 1 use 80 microvolts.

Step 8. Turn attenuator to X1 and function switch to field intensity position.

Step 9. Adjust signal generator to 20 megacycles. Tune RFI Meter for maximum response. Adjust generator output for an RFI output meter indication of 80 microvolts, same as the calibrator setting in Step 7. Note the generator output in microvolts.

Step 10. Divide the signal generator output in microvolts by the 6 db bandwidth in kilocycles determined in Step 6. This factor is the peak output of the calibrator in microvolts per 1 kc bandwidth.

Step 11. To use the factor derived in Step 10 in determining bandwidth at other frequencies repeat Steps 7 and 9 at each test frequency. The generator output in microvolts from Step 9 divided by the factor in Step 10 will be the 6 db bandwidth in kilocycles. The random noise bandwidth can be determined by dividing the 6 db bandwidth by 1.35. The impulse bandwidth can be determined by multiplying the 6 db bandwidth by 1.11.

Step 12. Using the vertical scale of Charts 6 and 7, plot the points of random noise bandwidth determined in Step 12. Draw a smooth curve through the plotted points.

3.8.2.2 Charts 1 and 2 Calibration Settings. -

Step 1. Set the following operating controls as indicated:

ATTENUATOR - As called for

FUNCTION SWITCH - As called for

PEAK - - As called for

PEAK SENS - As called for

TUNING dial frequency - As called for

Step 2. Using the RF transmission line 90933-1, connect the RFI Meter to the output of the signal generator.

NOTE

The absolute value of calibration depends on the accuracy of the calibrating source.

Step 3. Adjust the signal generator frequency to 20 megacycles. Adjust the output to 100 microvolts.

Step 4. Set the RFI Meter attenuator to X1 position, function switch to FIELD INTENSITY position. Tune the RFI Meter for maximum response to the test signal. Adjust the CALIBRATE control for M101 indication of 100 microvolts.

Step 5. Set the attenuator and function switches to the CAL position. Set the PEAK MODE switch to the MANUAL position. Turn the PEAK control maximum clockwise.

Step 6. Turn the PEAK control counterclockwise until the visual PEAK indicator, I102, blinks in unison with the pulses emitted by the calibrator (headphones may be used for aural identification). Then rotate the PEAK control clockwise until I102 just ceases to blink. Note the indication on the db scale of M101 and record.

NOTE

The aural null method may be used to verify visual null measurement of calibrator pulse amplitude.

Step 7. Repeat Steps 3 through 6 for each of the test frequencies in Bands 1 through 4.

Step 8. Using the vertical scale of Charts 1 and 2, plot the values of calibrator pulse amplitude in db which were determined in Step 6. Draw a smooth curve through the plotted points.

Step 9. Repeat Steps 3 and 4 at test frequency of 145 megacycles in band 5. Then reduce signal generator output to zero. If M101 indication is less than one microvolt use 100 microvolt signal generator output as suggested in Step 3. If M101 indication is greater than one microvolt use a signal generator output of 200 microvolts in Step 3.

Step 10. Repeat Steps 3 through 6 for each of the test frequencies in band 5 but using signal generator output indicated by Step 10. If 100 microvolts is used, the correction factor for band 5 will be 1. If 200 microvolts is used the correction factor for band 5 will be 2.

Step 11. Using the vertical scale of Charts 1 and 2, plot the values of calibrator amplitude in db which were determined in Step 6. Draw a smooth curve through the plotted points.

Step 12. For test frequencies in band 6, a different procedure will be used as the sensitivity will not reach the two microvolt level at some frequencies.

a) Set up the following operating controls:

ATTENUATOR - X1

FUNCTION SWITCH - FI

b) Tune the RI-FI Meter for maximum response to a generator test signal at a frequency of 240 megacycles.

c) Decrease signal generator output to zero. Adjust CAL control for an M101 indication of one microvolt. Adjust signal generator output for an M101 indication of 100 microvolts. Note signal generator output in microvolts. Use the nearest rounded off number to 100 microvolts: i.e., 300, 400, 500, or 600. This will become the correction factor for band 6 and will be the signal generator input for all tested frequencies as listed in the table in Step 6. This divided by 100 will be the correction factor.

d) Tune the RI-FI Meter for maximum response to the generator signal. Adjust the CAL control for an M101 indication of 100 microvolts.

e) Set the attenuator and function switch to the CAL position and the PEAK MODE switch to the MANUAL position.

f) Rotate the PEAK control counterclockwise until the PEAK indicator lamp blinks in step withthe calibrator pulses, then adjust clock-

wise until the lamp just ceases to blink. Note indication in db on M101. This is the calibrator setting at this test frequency.

g) Repeat Steps (b) through (f) for each remaining test frequency in band 6, using the factor established in (c). Plot calibrator settings on band 6 chart. Draw a smooth curve through the plotted points. Should there be insufficient range in the CAL control for Step (d) at test frequencies in the middle portion of band, RF realignment of band 6 is indicated (see paragraph 3. 7. 5. 3).

3. 8. 3 Other Chart Settings. -

Charts 3, 4, 5, 8, and 9 are not influenced by realignment of the **RI-FI Meter; therefore,** no corrections need be made.

TABLE 3, ELECTRON TUBE OPERATING VOLTAGE

SYMBOL	TUBE TYPE	FUNCTION	PLATE (VOLTS)	SCREEN (VOLTS)	SUPP. (VOLTS)	CATH (VOLTS)	GRID (VOLTS)	HEATER (VOLTS)
V106	6BH6	1st I-F Amplifier	220	212	0	12	0	6.3
V107	6BH6	2nd I-F Amplifier	220	185	0	4.4	0	6.3
V108	6BH6	3rd I-F Amplifier	220	188	0	4.4	0	6.3
V109	6BH6	4th I-F Amplifier	220	163	0	1.3	0	6.3
V110	6005	5th I-F Amplifier	205	196	13	13	0	6.3
V111	5726	Detector	(2)-0.1 (7)-0.05	-	-	(1) 0.45 (5) 0.45	-	6.3
V112	6135	Beat-Frequency Oscillator	128*	-	-	0*	0.75*	6.3
V113	6AU6WA	Video Amplifier	123	156	0	1.55	0	6.3
V114	6135	Audio Amplifier	218	-	-	7.3	0	6.3
V115	6BH6	Pulse Amplifier	218	155	0	1.1	0	6.3
V116	5814	Trigger Multivibrator	(1) 112 (6) 223	-	-	(3) 47 (8) 47	36 (2) 18 (7)	6.3
V117	6BH6	Pulse Amplifier	222	223	0	0	-39	6.3
V119	6135	Vacuum-Tube Voltmeter	110	-	0	3.5	0	6.3
V120	6135	Vacuum-Tube Voltmeter	110	-	-	3.5	0	6.3
V121	5814	Impulse Generator	(1) 150** (6) 150	-	-	(3)-76 ** (0)-76	-40 (2) ** -72 (7)	6.3
V122	OA2	Voltage Regulator	150	-	-	0	-	-
V301	OB2	Full-Wave Rectifier	(4) 340 (ac)			-105	-	-

1. All numbers within parentheses designate pin numbers.
2. All measurements are made with attenuator on X_1, function switch on FIELD INTENSITY, unless otherwise indicated.
3. Above voltages are typical and will vary slightly from unit to unit.
4. All measurements are made from point indicated to chassis, except heater voltages which are measured across tube socket heater connections.

* Function switch in BFO position.
** Function switch in CAL position.

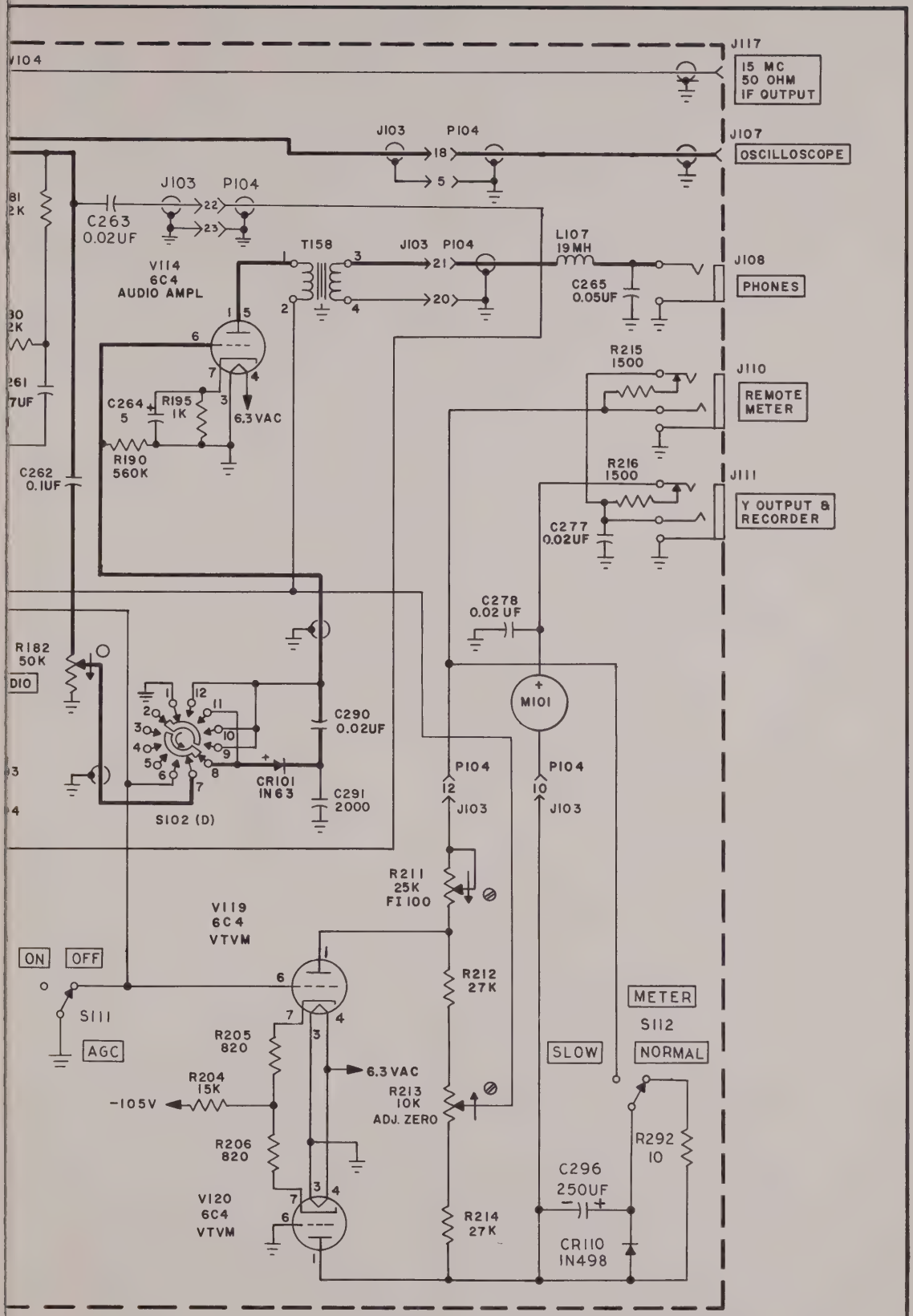


FIGURE 3-1. SCHEMATIC DIAGRAM, NM-30A RADIO INTERFERENCE-FIELD INTENSITY MEASURING EQUIPMENT

(SHEET 2 OF 3)

TABLE 3, ELECTRON TUBE OPERATING VOLTAGE

SYMBOL	TUBE TYPE	FUNCTION	PLATE (VOLTS)	SCREEN (VOLTS)	SUPP. (VOLTS)	CATH (VOLTS)	GRID (VOLTS)	HEATER (VOLTS)
V106	6BH6	1st I-F Amplifier	220	212	0	12	0	6.3
V107	6BH6	2nd I-F Amplifier	220	185	0	4.4	0	6.3
V108	6BH6	3rd I-F Amplifier	220	188	0	4.4	0	6.3
V109	6BH6	4th I-F Amplifier	220	163	0	1.3	0	6.3
V110	6005	5th I-F Amplifier	205	196	13	13	0	6.3
V111	5726	Detector	(2)-0.1 (7)-0.05	-	-	(1) 0.45 (5) 0.45	-	6.3
V112	6135	Beat-Frequency Oscillator	128*	-	-	0*	0.75*	6.3
V113	6AU6WA	Video Amplifier	123	156	0	1.55	0	6.3
V114	6135	Audio Amplifier	218	-	-	7.3	0	6.3
V115	6BH6	Pulse Amplifier	218	155	0	1.1	0	6.3
V116	5814	Trigger Multivibrator	(1) 112 (6) 223	-	-	(3) 47 (8) 47	36 (2) 18 (7)	6.3
V117	6BH6	Pulse Amplifier	222	223	0	0	-39	6.3
V119	6135	Vacuum-Tube Voltmeter	110	-	0	3.5	0	6.3
V120	6135	Vacuum-Tube Voltmeter	110	-	-	3.5	0	6.3
V121	5814	Impulse Generator	(1) 150** (6) 150	-	-	(3)-76 ** (0)-76	-40 (2) ** -72 (7)	6.3
V122	OA2	Voltage Regulator	150	-	-	0	-	-
V301	OB2	Full-Wave Rectifier	(4) 340 (ac)			-105	-	-

1. All numbers within parentheses designate pin numbers.
2. All measurements are made with attenuator on X_1, function switch on FIELD INTENSITY, unless otherwise indicated.
3. Above voltages are typical and will vary slightly from unit to unit.
4. All measurements are made from point indicated to chassis, except heater voltages which are measured across tube socket heater connections.

* Function switch in BFO position.
** Function switch in CAL position.

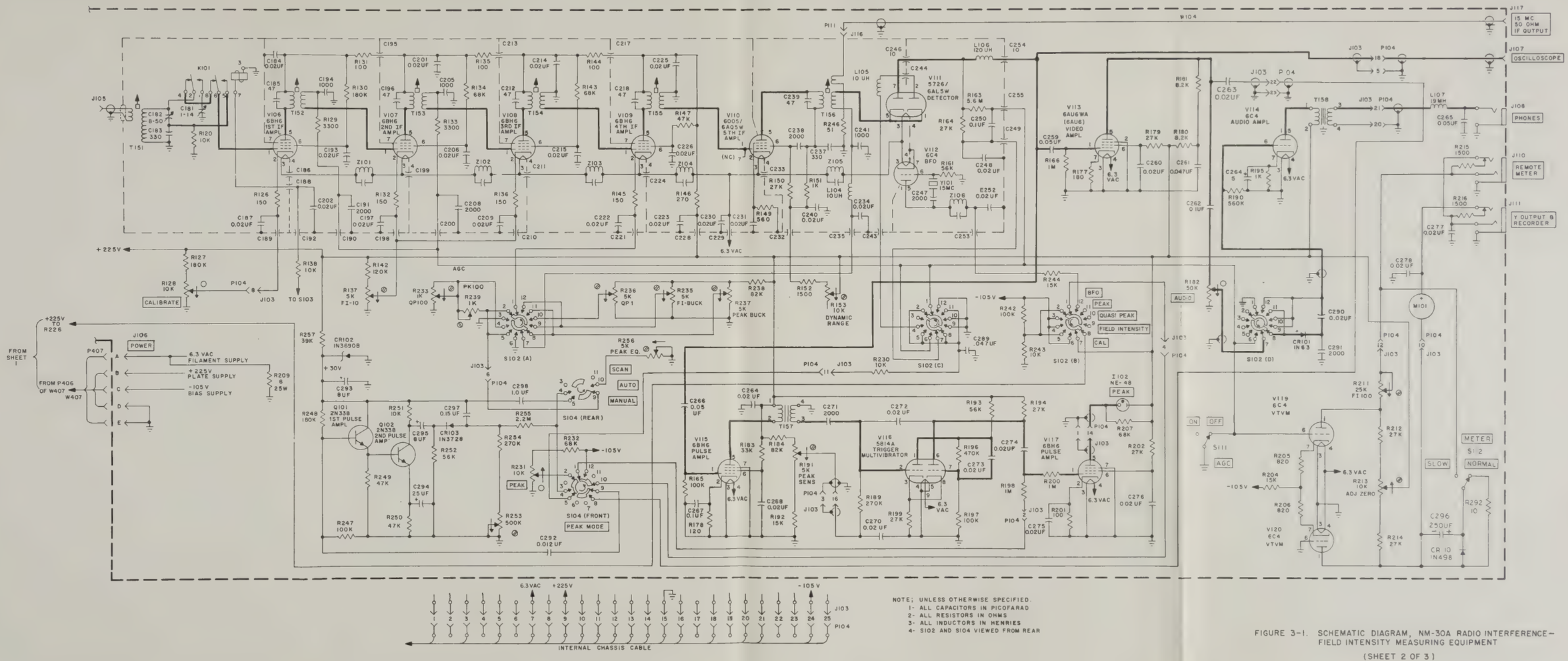


FIGURE 3-1. SCHEMATIC DIAGRAM, NM-30A RADIO INTERFERENCE-FIELD INTENSITY MEASURING EQUIPMENT

(SHEET 2 OF 3)

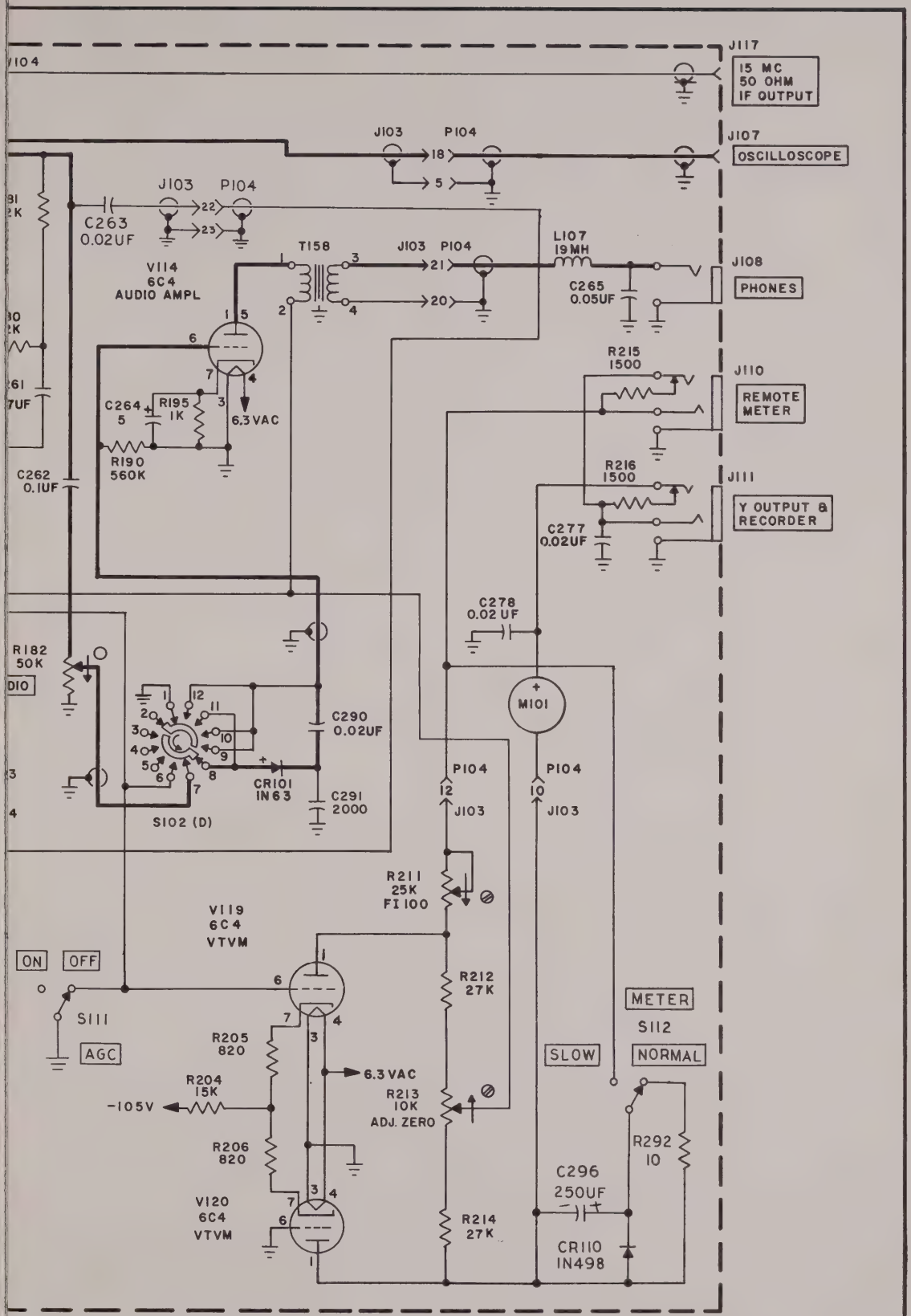


FIGURE 3-1. SCHEMATIC DIAGRAM, NM-30A RADIO INTERFERENCE–FIELD INTENSITY MEASURING EQUIPMENT

(SHEET 2 OF 3)

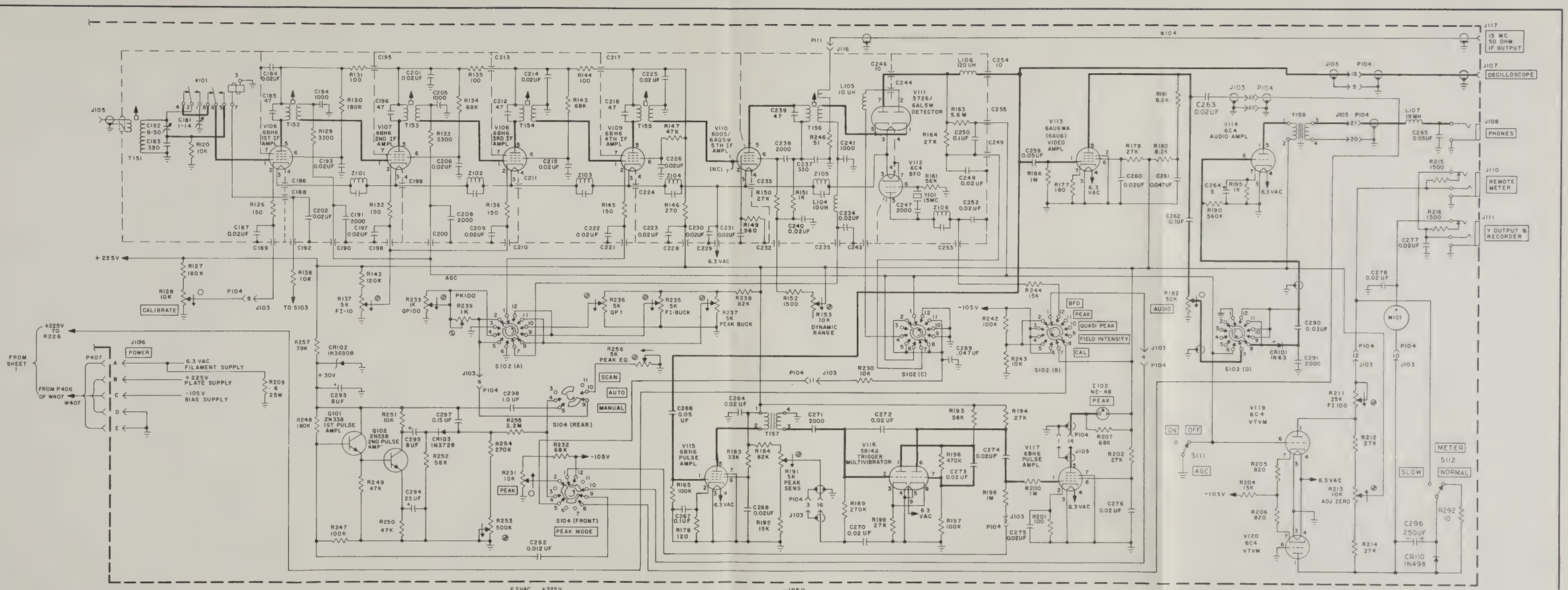


FIGURE 3-1. SCHEMATIC DIAGRAM, NM-30A RADIO INTERFERENCE-FIELD INTENSITY MEASURING EQUIPMENT

(SHEET 2 OF 3)

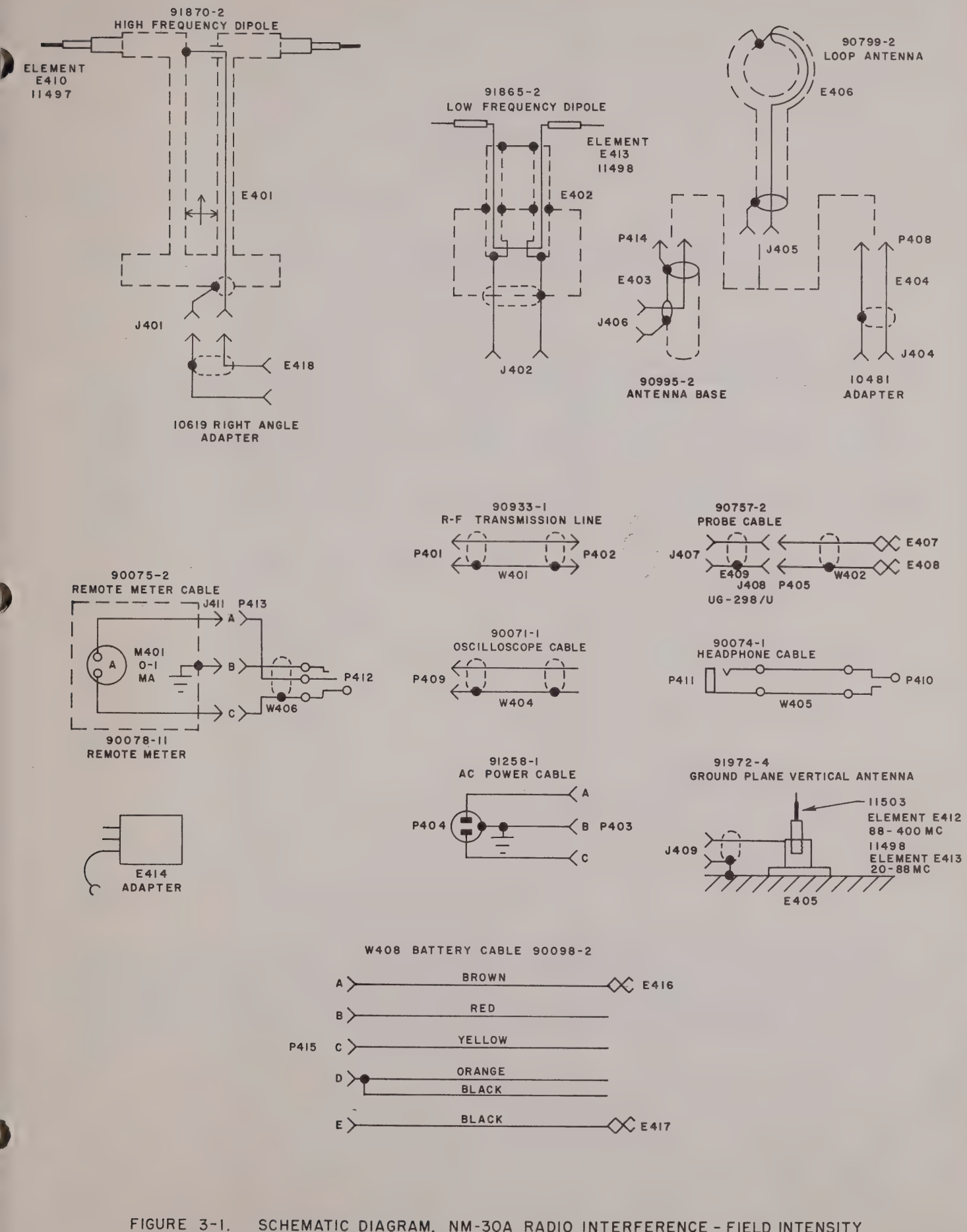


FIGURE 3-1. SCHEMATIC DIAGRAM, NM-30A RADIO INTERFERENCE - FIELD INTENSITY MEASURING EQUIPMENT (SHEET 3 OF 3)

SECTION IV
PARTS LIST

4.1 INTRODUCTION

This section contains a list of replaceable parts for the Model NM-30A Radio Interference-Field Intensity measuring equipment.

4.2 REFERENCE DESIGNATIONS

Reference or circuit designations have been assigned to identify all maintenance parts of the receiver and are used on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (typical group) such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Parts of the same first major unit are numbered 101 to 299, parts of the second 301 to 399, etc. The following table is arranged by the groups of reference designations that apply to a major unit. Thus when the reference designation of a part is known, this table will furnish ready reference to the major unit in which it is used.

Table 4-1. NM-30A Equipment, List of Major Units

REF. DESIG.	NAME OF MAJOR UNIT
101-299	NM-30A RADIO INTERFERENCE-FIELD INTENSITY METER
301-399	POWER SUPPLY Model No. 91923-2 NOTE Refer to Appendix "A" for the 91923-2 Power Supply Parts List
401-499	ACCESSORIES GROUP

4.3 MAINTENANCE PARTS LIST

The following parts list pages list the reference designations of the various parts in alphabetical and numerical order. Complete information is given for all key parts (parts differing from any part previously listed) and sub-key parts (parts identical with a key part but the name and description are omitted). However, reference is made to the key part by (same as ---) data.

SYMBOL	DESCRIPTION	STODDART NO.
C101	CAPACITOR, VARIABLE: 1 to 10 pf; p/o Z201; Roanwell No. SG 11054	18137
C102	Same as C101 (p/o Z202)	
C103	Same as C101 (p/o Z203)	
C104	Same as C101 (p/o Z204)	
C105	Same as C101 (p/o Z205)	
C106	Same as C101 (p/o Z206)	
C107	Not used	
C108	CAPACITOR, VARIABLE, AIR: 3 to 24.5 pf; 800 vdcw; Stoddart 10485	10485
C109	CAPACITOR, FIXED, CERAMIC: 1,000 pf; GMV; 500 vdcw; Mucon No. SO-1333	10444
C110	Same as C109	
C111	Same as C109	
C112	Same as C109	
C113	Same as C109	
C114	Not used	
C115	CAPACITOR, FIXED, CERAMIC: 1500 pf; ± 20%; feedthru type; 500 vdcw Erie No. 362-03	10364
C116	Same as C115	
C117	Same as C115	
C118	CAPACITOR, FIXED, CERAMIC: 20,000 pf; GMV; 400 vdcw; Erie No. 811Z5V203P	10493
C119	CAPACITOR, VARIABLE, AIR: 3 to 24.5 pf; 800 vdcw; Stoddart 10486	10486
C120	CAPACITOR, FIXED, CERAMIC: 5,000 pf; 500 vdcw; Mucon, H1-K series	10998
C121	Same as C101 (p/o Z211)	
C122	Same as C101 (p/o Z212)	
C123	Same as C101 (p/o Z213)	
C124	Same as C101 (p/o Z214)	
C125	Same as C101 (p/o Z215)	
C126	Same as C101 (p/o Z216)	
C127	Same as C109	
C128 thru C130	Not used	
C131	Same as C101 (p/o Z221)	
C132	Same as C101 (p/o Z222)	
C133	Same as C101 (p/o Z223)	
C134	Same as C101 (p/o Z224)	
C135	Same as C101 (p/o Z225)	
C136	Same as C101 (p/o Z226)	
C137	Same as C108	
C138	Same as C109	
C139	Same as C109	
C140	CAPACITOR, FIXED, CERAMIC: 15 pf; 1%; 500 vdcw; MIL type CC20-150F	10664-150
C141	Same as C140	
C142 thru C145	Not used	
C146	Same as C109	
C147	Same as C109	
C148 thru C150	Not used	
C151	CAPACITOR, FIXED, CERAMIC: 47.7 pf; ± 1%; 500 vdcw; Vitramon type 70	10671
C152	CAPACITOR, FIXED, CERAMIC: 74.4 pf; ± 1%; 500 vdcw; Vitramon type 70	10672
C153	CAPACITOR, FIXED, CERAMIC: 120.8 pf; ± 1%; 500 vdcw; Vitramon type 70	10673
C154	CAPACITOR, FIXED, CERAMIC: 197.7 pf; ± 1%; 500 vdcw; Vitramon type 70	10674
C155	CAPACITOR, FIXED, MICA: 323 pf; ± 2%; 500 vdcw; Erie No. 370CA323J	10734
C156	CAPACITOR, FIXED, MICA: 750 pf; ± 2%; 500 vdcw; Erie No. 370CA751J	10779

SYMBOL	DESCRIPTION	STODDART NO.
C157	Not used	
C158	Same as C119	
C159	CAPACITOR, FIXED, CERAMIC: 33 pf; ± 5%; 500 vdcw; MIL type CC20-330J	10745
C160	Same as C109	
C161	Same as C101 (p/o Z231)	
C162	Same as C101 (p/o Z232)	
C163	Same as C101 (p/o Z233)	
C164	Same as C101 (p/o Z234)	
C165	Same as C101 (p/o Z235)	
C166	Same as C101 (p/o Z236)	
C167 thru C169	Not used	
C170	Same as C120	
C171	Same as C115	
C172	Same as C115	
C173	Same as C115	
C174	Not used	
C175	Same as C109	
C176	Same as C109	
C177	Same as C115	
C178	Same as C118	
C179 and C180	Not used	
C181	CAPACITOR, VARIABLE, CERAMIC: 1 to 14 pf; 600 vdcw; Stoddart No. 90787-1	90787-1
C182	CAPACITOR, VARIABLE, CERAMIC: 8 to 50 pf; 350 vdcw; Erie style 557	10787
C183	CAPACITOR, FIXED, CERAMIC: 330 pf; ± 1%; 500 vdcw; Vitramon type 71	10666-331
C184	Same as C118	
C185	CAPACITOR, FIXED, CERAMIC: 47 pf; ± 1%; 500 vdcw; Vitramon type 70	10704-470
C186	Same as C115	
C187	Same as C118	
C188	Same as C115	
C189	Same as C115	
C190	Same as C115	
C191	CAPACITOR, FIXED, CERAMIC: disc type; 2,000 pf; +100% -0%; 500 vdcw; Erie No. 801-0.002	10668
C192	Same as C115	
C193	Same as C118	
C194	CAPACITOR, FIXED, CERAMIC: stand-off type; 1,000 pf; 500 vdcw; Sprague No. 507C-1000	10665
C195	Same as C115	
C196	Same as C185	
C197	Same as C118	
C198	Same as C115	
C199	Same as C115	
C200	Same as C115	
C201	Same as C118	
C202	Same as C118	
C203 and C204	Not used	
C205	Same as C194	
C206	Same as C118	
C207	Not used	
C208	Same as C191	
C209	Same as C118	
C210	Same as C115	
C211	Same as C115	
C212	Same as C185	

SYMBOL	DESCRIPTION	STODDART NO.
C213	Same as C115	
C214	Same as C118	
C215	Same as C118	
C216	Not used	
C217	Same as C115	
C218	Same as C185	
C219 and C220	Not used	
C221	Same as C115	
C222	Same as C118	
C223	Same as C118	
C224	Same as C115	
C225	Same as C118	
C226	Same as C118	
C227	Not used	
C228	Same as C115	
C229	Same as C115	
C230	Same as C118	
C231	Same as C118	
C232	Same as C115	
C233	Same as C115	
C234	Same as C118	
C235	Same as C115	
C236	Not used	
C237	Same as C183	
C238	Same as C191	
C239	Same as C185	
C240	Same as C118	
C241	Same as C194	
C242	Not used	
C243	Same as C115	
C244	Same as C115	
C245	Not used	
C246	CAPACITOR, FIXED, CERAMIC: feed-thru type; 10 pf; ± 20%; 1,000 vdcw; Erie type 362-GP(SL)	10389
C247	Same as C191	
C248	Same as C118	
C249	Same as C115	
C250	CAPACITOR, FIXED, PAPER: 100,000 pf; ± 10%; 400 vdcw; Sprague No. 91P10494-S11	10669
C251	Not used	
C252	Same as C118	
C253	Same as C115	
C254	Same as C246	
C255	Same as C115	
C256 thru C258	Not used	
C259	CAPACITOR, FIXED, PAPER: 50,000 pf; +20% -10%; 200 vdcw; Westcap 15L2503-3	10196
C260	Same as C118	
C261	CAPACITOR, FIXED, PAPER: 47,000 pf; ± 20%; 300 vdcw; Westcap 13M3473-1	10670
C262	CAPACITOR, FIXED, PAPER: 100,000 pf; -10%; 300 vdcw; Westcap 64K4104-3	10101
C263	Same as C118	
C264	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 5.0 µf; +50% - 15%; 50 vdcw; Fansteel No. PP5B50A2	10677

SYMBOL	DESCRIPTION	STODDART NO.
C265	Same as C259	
C266	Same as C259	
C267	CAPACITOR, FIXED, PAPER: 100,000 pf; ± 20%; 200 vdcw; Westcap 12M2104-1	10678
C268	Same as C118	
C269	Same as C118	
C270	Same as C118	
C271	Same as C191	
C272	Same as C118	
C273	Same as C118	
C274	Same as C118	
C275	Same as C118	
C276	Same as C118	
C277	Same as C118	
C278	Same as C118	
C279	CAPACITOR, FIXED, CERAMIC: 8.2 pf; ± 5%; 300 vdcw; JFD UY028R2J	18333
C280	Same as C279	
C281	CAPACITOR, FIXED, CERAMIC: tubular; 330 pf; 500 vdcw; Erie type GP2K	10667-331
C282	Not used	
C283	Same as C118	
C284	Same as C250	
C285	Same as C118	
C286	Same as C118	
C287	Same as C118	
C288	Not used	
C289	CAPACITOR, FIXED, MYLAR: 0.047 µf; ± 20%; 200 vdcw; Westcap No. 4M473	18198
C290	Same as C118	
C291	Same as C191	
C292	CAPACITOR, FIXED, CERAMIC: 0.012 µf; ± 10%; 200 vdcw; Mucon 2E012RK	18199
C293	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 8 µf; 50 vdcw; Mallory TNT-805U050-P0B	18200
C294	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 25 µf; 15 vdcw; Mallory TNT-256U015-P0B	18201
C295	Same as C293	
C296	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 250 µf; 10 vdcw; Fansteel F304	11567
C297	CAPACITOR, FIXED, MYLAR: 0.915 µf; ± 10%; 200 vdcw; Westcap WF70K2154	18202
C298	CAPACITOR, FIXED, MYLAR: 1.0 µf; ± 10%; 200 vdcw; Westcap WF70K2105	18203
C299 and C300	Not used	
CR101	CRYSTAL UNIT, RECTIFYING: type 1N63 Sylvania type 1N63	10679
CR102	SEMICONDUCTOR DEVICE, DIODE: zener; 30 v; ± 5%; Motorola type 1N3690B	1N3690B
CR103	SEMICONDUCTOR DEVICE, DIODE: silicon; Raytheon/Rheem 1N3728	1N3728
CR104 thru CR109	Not used	
CR110	SEMICONDUCTOR DEVICE, DIODE: germanium type	1N498

RFI METER

SYMBOL	DESCRIPTION	STODDART NO.
E100 thru E135	Not used	
E136	NETWORK, IMPEDANCE MATCHING: coaxial; 50 ohms; p/o Z113; Stoddart assy 90831-1	90831-1
E137	TRANSMISSION LINE SECTION: 50 ohms; p/o Z113; Stoddart assy 90388-1	90388-1
E138	Same as E137	
E139	RESISTOR ASSEMBLY: fixed T-section attenuator; 20 db; 50 ohms; p/o Z113; Stoddart assy 90389-1	90389-1
E140	RESISTOR ASSEMBLY: fixed T-section attenuator; 40 db; 50 ohms; p/o Z113; Stoddart assy 90389-2	90389-2
E141	RESISTOR ASSEMBLY: fixed T-section attenuator; 60 db; 50 ohms; p/o Z113; Stoddart assy 90389-3	90389-3
E142	Not used	
E143	SHELL CONNECTOR: junction; for use with DB-25 connector; Cannon type DB	10612
E144	SHELL CONNECTOR: junction; Winchester type H-10	10615
E145 thru E299	Not used	
I101	LAMP, INCANDESCENT: miniature 6 to 8 v; General Electric No. 47	10051
I102	LAMP, GLOW: indicator type; General Electric No. 48	10726
J101	CONNECTOR, RECEPTACLE: radio frequency; coaxial; p/o Z114 (reference only)	
J102	CONNECTOR, ADAPTER: coaxial type; right angle; modified MIL type UG-27A/U; Stoddart drawing no. 10356	10356
J103	CONNECTOR, PLUG: male; 25 contacts Cannon type DB-25P	10732
J104	CONNECTOR, RECEPTACLE: coaxial; p/o Z114 (reference only)	
J105	CONNECTOR, RECEPTACLE: coaxial, modified UG-290/U; Stoddart dwg 10616	10616
J106	CONNECTOR, RECEPTACLE: male; 5 contacts, Cannon No. 3102E-14S-5P	11178
J107	CONNECTOR, RECEPTACLE: coaxial; MIL type; UG-290/U	10121
J108	JACK, TELEPHONE: for 2-conductor plug; MIL type JJ-034	10122
J109	CONNECTOR, POWER: male; 4 contacts; Winchester M4PLRN	10613
J110	JACK, TELEPHONE: for 3-conductor plug Switchcraft, Littlejack S-13B	10123
J111	Same as J110	
J112	CONNECTOR, RECEPTACLE: coaxial p/o S101 (reference only	
J113	CONNECTOR, RECEPTACLE: coaxial p/o S101 (reference only)	
J114	CONNECTOR, PLUG: modified UG-625/U, Stoddart dwg 10727	10727
J115	Same as J114	
J116	CONNECTOR, RECEPTACLE: female; right angle type; Microdot 31-61	11467
J117	Same as J107	
J118	CONNECTOR, RECEPTACLE: female; "X" output; Electro Physics R95-2200	11682
K101	RELAY: dpdt; 30 volts; 3 amps; 4700 ohms dc resistance; North Elec. 517796	10618
L101	CHOKE, RADIO FREQUENCY:	10617
L102	Same as L101	
L103	Same as L101	
L104	CHOKE, RADIO FREQUENCY: 10μh	10360
L105	Same as L104	
L106	CHOKE, RADIO FREQUENCY: 120μh	10692
L107	CHOKE, RADIO FREQUENCY: Stoddart assy. 90825-1	90825-1
M101	METER, MULTI-SCALE: dc; 0-1 ma Stoddart dwg. 13702	13702
P101	CONNECTOR, PLUG: coaxial; male type "N" Stoddart assy. 90399-2	90399-2
P102	Same as P101	
P103	CONNECTOR, PLUG: UG-88/U	10084
P104	CONNECTOR, RECEPTACLE: female; 25 contacts; C annon No. DB-255	10683
P105	Same as P101	
P106	Same as P101	
P107	Same as P103	
P108	Same as P103	
P109	CONNECTOR, RECEPTACLE: female 4 contacts; Winchester M4S-LS	10614
P110	Same as P101	
P111	CONNECTOR, PLUG: male; single contact (reference only)	
Q101	TRANSISTOR: NPN type; Texas Instrument type 2N338	2N338
Q102	Same as Q101	
R101	RESISTOR, FIXED, COMPOSITION: 39,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-3935	10011-393
R102	RESISTOR, FIXED, COMPOSITION: 100,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-1045	10693-104
R103	RESISTOR, FIXED, COMPOSITION: 220,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-2245	10693-224
R104	Same as R103	
R105	Same as R101	
R106	RESISTOR, FIXED, COMPOSITION: 2700 ohms; ± 5%; 1/2 w Allen Bradley No. EB-2725	10011-272
R107	RESISTOR, FIXED, COMPOSITION: 2200 ohms; ± 5%; 1/2 w Allen Bradley No. EB-2225	10011-222
R108	RESISTOR, FIXED, COMPOSITION: 1500 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1525	10011-152
R109	RESISTOR, FIXED, COMPOSITION: 100,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1045	10011-104
R110	Not used	
R111	Same as R103	
R112	Same as R103	
R113	RESISTOR, FIXED, COMPOSITION: 680,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-6845	10011-684
R114	Same as R113	
R115	RESISTOR, FIXED, COMPOSITION: 1,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1025	10011-102

RFI METER

SYMBOL	DESCRIPTION	STODDART NO.
R116	RESISTOR, FIXED, COMPOSITION: 100 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1015	10011-101
R117	Same as R116	
R118	Same as R116	
R119	Same as R116	
R120	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1035	10011-103
R121	RESISTOR, FIXED, WIREWOUND: 1,500 ohms; ± 5%; 25 w Dale Mfg. type RH-25-1.5K-25W-5%	10705-152
R122	Not used	
R123	RESISTOR, FIXED, COMPOSITION: 33 ohms; ± 5%; 1/4 w Allen Bradley No. CB-3305	10693-330
R124	RESISTOR, FIXED, COMPOSITION: 3900 ohms; ± 5%; 1/2 w Allen Bradley No. EB-3925	10011-392
R125	RESISTOR, FIXED, COMPOSITION: 56,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-5635	10011-563
R126	RESISTOR, FIXED, COMPOSITION: 150 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1515	10011-151
R127	RESISTOR, FIXED, COMPOSITION: 180,000 ohms; ± 5%; 1 w Allen Bradley No. GB-1845	10012-184
R128	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms; ± 10%; 2 w Allen Bradley No. JA1G048P103UA	10408
R129	RESISTOR, FIXED, COMPOSITION: 3300 ohms; ± 5%; 1/2 w Allen Bradley No. EB-3325	10011-332
R130	Same as R127	
R131	Same as R116	
R132	Same as R126	
R133	Same as R129	
R134	RESISTOR, FIXED, COMPOSITION: 68,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-6835	10011-683
R135	Same as R116	
R136	Same as R126	
R137	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms; ± 10%; 1/2 w Allen Bradley No. TSLU5022	10694
R138	RESISTOR, FIXED, WIREWOUND: 10,000 ohms; ± 5%; 25 w Dale Mfg. type RH25-10K-25W-5%	10705-103
R139 thru R141	Not used	
R142	RESISTOR, FIXED, COMPOSITION: 120,000 ohms; ± 5%; 1 w Allen Bradley No. GB-1245	10012-124
R143	Same as R134	
R144	Same as R116	
R145	Same as R126	
R146	RESISTOR, FIXED, COMPOSITION: 270 ohms; ± 5%; 1/2 w Allen Bradley No. EB-2715	10011-271
R147	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-4735	10011-473
R148	Not used	
R149	RESISTOR, FIXED, COMPOSITION: 560 ohms; ± 5%; 1/2 w Allen Bradley No. EB-5615	10011-561

SYMBOL	DESCRIPTION	STODDART NO.
R150	RESISTOR, FIXED, COMPOSITION: 27,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-2735	10011-273
R151	Same as R115	
R152	Same as R108	
R153	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms; ± 10%; 2 w Allen Bradley No. JA1040S103UC	10252
R154 thru R160	Not used	
R161	Same as R125	
R162	Not used	
R163	RESISTOR, FIXED, COMPOSITION: 5.6 megohm; ± 5%; 1/2 w Allen Bradley No. EB-5655	10011-565
R164	Same as R150	
R165	Same as R109	
R166	RESISTOR, FIXED, COMPOSITION: 1 megohm; ± 5%; 1/2 w Allen Bradley No. EB-1055	10011-105
R167 thru R176	Not used	
R177	RESISTOR, FIXED, COMPOSITION: 180 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1815	10011-181
R178	RESISTOR, FIXED, COMPOSITION: 120 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1215	10011-121
R179	Same as R150	
R180	RESISTOR, FIXED, COMPOSITION: 8200 ohms; ± 5%; 1 w Allen Bradley No. GB-8225	10012-822
R181	Same as R180	
R182	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms; ± 10%; 2 w Allen Bradley type J	10041
R183	RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-3335	10011-333
R184	RESISTOR, FIXED, COMPOSITION: 82,000 ohms; ± 5%; 1 w Allen Bradley No. GB-8235	10012-823
R185 thru R188	Not used	
R189	RESISTOR, FIXED, COMPOSITION: 270,000 ohms; ± 5%; 1 w Allen Bradley No. GB-2745	10012-274
R190	RESISTOR, FIXED, COMPOSITION: 560,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-5645	10011-564
R191	RESISTOR, VARIABLE, WIREWOUND: 5,000 ohms; ± 10%; 2 w Bowens type 3067-P, 5Kohm	18206
R192	RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1535	10011-153
R193	Same as R125	
R194	Same as R150	
R195	Same as R115	
R196	RESISTOR, FIXED, COMPOSITION: 470,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-4745	10011-474
R197	Same as R109	
R198	Same as R166	
R199	Same as R150	
R200	Same as R166	

RFI METER

SYMBOL	DESCRIPTION	STODDART NO.
R201	Same as R116	
R202	Same as R150	
R203	Same as R166	
R204	RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ± 5%; 1 w Allen Bradley No. GB-1535	10012-153
R205	RESISTOR, FIXED, COMPOSITION: 820 ohms; ± 5%; 1/2 w Allen Bradley No. EB-8215	10011-821
R206	Same as R205	
R207	Same as R134	
R208	RESISTOR, FIXED, WIREWOUND: 14,000 ohms; ± 5%; 25 w Dale Mfg. type RH25-14K-25W-5%	10705-143
R209	RESISTOR, FIXED, WIREWOUND: 6 ohms; ± 5%; 25 w Dale Mfg. type RH25-6ohms-25W-5%	10705-060
R210	Not used	
R211	RESISTOR, VARIABLE, COMPOSITION: 25,000 ohms; ± 10%; 1/2 w Allen Bradley No. TSLU2532	10685
R212	Same as R150	
R213	Same as R153	
R214	Same as R150	
R215	Same as R108	
R216	Same as R108	
R217 thru R220	Not used	
R221	Same as R116	
R222	RESISTOR, FIXED, COMPOSITION: 3.3 megohm; ± 5%; 1/2 w Allen Bradley No. EB-3355	10011-335
R223	Same as R222	
R224	RESISTOR, FIXED, COMPOSITION: 18,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1835	10011-183
R225	Same as R224	
R226	RESISTOR, FIXED, COMPOSITION: 680 ohms; ± 5%; 1/2 w Allen Bradley No. 6815	10011-681
R227	Same as R115	
R228	Same as R189	
R229	RESISTOR, FIXED, COMPOSITION: 240,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-2445	10011-244
R230	Same as R120	
R231	Same as R128	
R232	Same as R134	
R233	RESISTOR, VARIABLE, COMPOSITION: 1,000 ohms; ± 10%; 1/2 w Allen Bradley No. TSLU1022	10686
R234	Not used	
R235 thru R237	Same as R137	
R238	RESISTOR, FIXED, COMPOSITION: 82,000 ohms; ± 5%; 2 w Allen Bradley No. HB-8235	10377-823
R239	RESISTOR, VARIABLE, WIREWOUND: 1000 ohms; 1/2 w; Bourns 30675-1-102	18332
R240 and R241	Not used	
R242	Same as R109	
R243	Same as R120	
R244	Same as R204	
R245	RESISTOR, FIXED, COMPOSITION: 10 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1005	10011-100
R246	RESISTOR, FIXED, COMPOSITION: 51 ohms; ± 5%; 1/2 w Allen Bradley No. EB-5105	10011-510
R247	Same as R102	
R248	RESISTOR, FIXED, COMPOSITION: 180,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-1845	11693-184
R249	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-4735	11693-473
R250	Same as R249	
R251	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-1035	11693-103
R252	RESISTOR, FIXED, COMPOSITION: 56,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-5635	11693-563
R253	RESISTOR, VARIABLE, COMPOSITION: 500,000 ohms; ± 20%; 1/8 w Chicago Tele. type 220-2, 220S504B	18204
R254	RESISTOR, FIXED, COMPOSITION: 270,000 ohms; ± 5%; 1/4 w Allen Bradley No. CB-2745	11693-274
R255	RESISTOR, FIXED, COMPOSITION: 2.2 megohms; ± 5%; 1/4 w Allen Bradley No. CB-2255	11693-225
R256	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms; ± 20%; 1/8 w Chicago Tele. type 220-2, 220S502B	18205
R257	RESISTOR, FIXED, COMPOSITION: 39,000 ohms; ± 5%; 2 w Allen Bradley No. HB-3935	10377-393
R258 thru R280	Not used	
R281	RESISTOR, FIXED, COMPOSITION: 180,000 ohms; ± 5%; 1/2 w Allen Bradley No. EB-1845	10011-184
R282	RESISTOR, VARIABLE, WIREWOUND: 10,000 ohms; ± 3%; 1.5 w; linear taper ± 0.25%; 10 turn, Spectrol 510	18099
R283 thru R289	Not used	
R290	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms; ± 10%; 2 w Allen Bradley No. JLU-5031-SD-4040L	10379-503
R291	RESISTOR, VARIABLE, COMPOSITION: 1000 ohms; ± 10%; 2 w Allen Bradley No. JLU-1021-SD-4040L	10379-102
R292	RESISTOR, FIXED, COMPOSITION: 10 ohms; ± 5%; 1/4 w Allen Bradley No. CB-1005	11693-100
S101	SWITCH, COAXIAL: includes J112 and J113, Stoddart assy 90801-1	90801-1
S102	SWITCH, ROTARY: 5 positions; 5 sections; Stoddart drawing no. 18097	18097
S103	SWITCH, SENSITIVE: 2 circuit; double break; G.E. CR1070-C130F3	11601
S104	SWITCH, ROTARY: wafer Stoddart drawing no. 18207	18207
S105 thru S110	Not used	
S111	SWITCH, ROTARY: 1 section, 2 position (concentric shaft, p/o R182)	18095
S112	SWITCH, TOGGLE: DPDT, Controls Co. of America no. T2150	18162

SYMBOL	DESCRIPTION	STODDART NO.
T101	TRANSFORMER, RADIO FREQUENCY: p/o Z201 (reference only); antenna coil, band 1	90961-1
T102	TRANSFORMER, RADIO FREQUENCY: p/o Z202 (reference only); antenna coil, band 2	90961-2
T103	TRANSFORMER, RADIO FREQUENCY: p/o Z203 (reference only); antenna coil, band 3	90961-3
T104	TRANSFORMER, RADIO FREQUENCY: p/o Z204 (reference only); antenna coil, band 4	90961-4
T105	TRANSFORMER, RADIO FREQUENCY: p/o Z205 (reference only); antenna coil, band 5	90961-5
T106	TRANSFORMER, RADIO FREQUENCY: p/o Z206 (reference only); antenna coil, band 6	90962-1
T107 thru T110	Not used	
T111	TRANSFORMER, RADIO FREQUENCY: p/o Z211 (reference only); R-F stage, plate circuit, band 1	90963-1
T112	TRANSFORMER, RADIO FREQUENCY: p/o Z212 (reference only); R-F stage, plate circuit, band 2	90963-2
T113	TRANSFORMER, RADIO FREQUENCY: p/o Z213 (reference only); R-F stage, plate circuit, band 3	90963-3
T114	TRANSFORMER, RADIO FREQUENCY: p/o Z214 (reference only); R-F stage, plate circuit, band 4	90963-4
T115	TRANSFORMER, RADIO FREQUENCY: p/o Z215 (reference only); R-F stage, plate circuit, band 5	90963-5
T116	TRANSFORMER, RADIO FREQUENCY: p/o Z216 (reference only); R-F stage, plate circuit, band 6	90964-1
T117 thru T120	Not used	
T121	TRANSFORMER, RADIO FREQUENCY: p/o Z221 (reference only); mixer stage, grid coil, band 1	90965-1
T122	TRANSFORMER, RADIO FREQUENCY: p/o Z222 (reference only); mixer stage, grid coil, band 2	90965-2
T123	TRANSFORMER, RADIO FREQUENCY: p/o Z223 (reference only); mixer stage, grid coil, band 3	90965-3
T124	TRANSFORMER, RADIO FREQUENCY: p/o Z224 (reference only); mixer stage, grid coil, band 4	90965-4
T125	TRANSFORMER, RADIO FREQUENCY: p/o Z225 (reference only); mixer stage, grid coil, band 5	90965-5
T126	TRANSFORMER, RADIO FREQUENCY: p/o Z226 (reference only); mixer stage, grid coil, band 6	90966-1
T127 thru T130	Not used	
T131	TRANSFORMER, RADIO FREQUENCY: p/o Z231 (reference only); oscillator coil, band 1	90967-1
T132	TRANSFORMER, RADIO FREQUENCY: p/o Z232 (reference only); oscillator coil, band 2	90967-2
T133	TRANSFORMER, RADIO FREQUENCY: p/o Z233 (reference only); oscillator coil, band 3	90967-3
T134	TRANSFORMER, RADIO FREQUENCY: p/o Z234 (reference only); oscillator coil, band 4	90967-4
T135	TRANSFORMER, RADIO FREQUENCY: p/o Z235 (reference only); oscillator coil, band 5	
T136	TRANSFORMER, RADIO FREQUENCY: p/o Z236 (reference only); oscillator coil, band 6	
T137 thru T149	Not used	
T150	TRANSFORMER, RADIO FREQUENCY: 15 Mc; mixer output transformer, Stoddart dwg 90837-1	90837-1
T151	TRANSFORMER, INTERMEDIATE FREQUENCY: 15 Mc; 1st IF, Stoddart dwg 90840-1	90840-1
T152	TRANSFORMER, INTERMEDIATE FREQUENCY: 15 Mc; 2nd IF, Stoddart dwg 90850-1	90850-1
T153	Same as T152	
T154	TRANSFORMER, INTERMEDIATE FREQUENCY: 15 Mc; 4th IF, Stoddart assy. 90948-1	90948-1
T155	TRANSFORMER, INTERMEDIATE FREQUENCY: 15 Mc; 5th IF, Stoddart assy. 90982-1	90982-1
T156	TRANSFORMER, INTERMEDIATE FREQUENCY: 15 Mc; IF output, Stoddart assy. 90860-1	90860-1
T157	TRANSFORMER, AUDIO FREQUENCY: coupling type; Stoddart dwg 10128	10128
T158	Same as T157	
T159 thru T299	Not used	
V101	ELECTRON TUBE: type 5840	5840
V102	Same as V101	
V103	Same as V101	
V104	Same as V101	
V105	ELECTRON TUBE: type 5718	5718
V106	ELECTRON TUBE: type 6BH6	6BH6
V107	Same as V106	
V108	Same as V106	
V109	Same as V106	
V110	ELECTRON TUBE: type 6005	6005
V111	ELECTRON TUBE: type 5726	5726
V112	ELECTRON TUBE: type 6C4	6C4
V113	ELECTRON TUBE: type 6AU6WA	6AU6WA
V114	Same as V112	
V115	Same as V106	
V116	ELECTRON TUBE: type 5814	5814
V117	Same as V106	
V118	Not used	
V119	Same as V112	
V120	Same as V112	
V121	Same as V116	
V122	ELECTRON TUBE: type OA2	OA2
V123 thru V299	Not used	
W101	CABLE ASSEMBLY, RADIO FREQUENCY: connects RF input to turret attenuator Stoddart assy. 90973-1	90973-1
W102	CABLE ASSEMBLY, RADIO FREQUENCY: connects coaxial switch to impulse noise generator, Stoddart assy. 90973-2	90973-2
W103	CABLE ASSEMBLY, RADIO FREQUENCY: connects low pass filter to coaxial switch Stoddart assy. 91035-1	91035-1

RFI METER

SYMBOL	DESCRIPTION	STODDART NO.
W104	CABLE ASSEMBLY, RADIO FREQUENCY: 15 Mc IF output cable connecting to J117 Stoddart dwg 11468	11468
W105 thru W299	Not used	
Y101	CRYSTAL UNIT, QUARTZ: 15 Mc Stoddart dwg 10690	10690
Z101	CHOKE, RADIO FREQUENCY: 15 Mc Stoddart assy. 90839-1	90839-1
Z102	Same as Z101	
Z103	Same as Z101	
Z104	Same as Z101	
Z105	Same as Z101	
Z106	CHOKE, RADIO FREQUENCY: 15 Mc Stoddart assy. 90947-1	90947-1
Z107	GENERATOR: impulse Stoddart assy. 90857-1	90857-1
Z108 thru Z112	Not used	
Z113	ATTENUATOR, RADIO FREQUENCY: consists of E136 thru E141, J102, S101 Stoddart assy. 90802-1	90802-1
Z114	ISOLATING CAPACITOR ASSEMBLY: Stoddart dwg 91232-1	91232-1
Z115	FILTER, LOW-PASS: 470 Mc cut-off; 50 ohms	91033-1
Z116 thru Z200	Not used	
Z201	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T101, C101	90841-2
Z202	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T102, C102	90842-2
Z203	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T103, C103	90843-2
Z204	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T104, C104	90844-2
Z205	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T105, C105	90845-2
Z206	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T106, C106	90846-2
Z207 thru Z210	Not used	
Z211	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T111, C121	90851-2
Z212	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T112, C122	90852-2
Z213	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T113, C123	90853-2
Z214	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T114, C124	90854-2
Z215	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T115, C125 and R116	90855-2
Z216	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T116, C126 and R117	90856-2
Z217 thru Z220	Not used	
Z221	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T121, C131	90861-2
Z222	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T122, C132	90862-2
Z223	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T123, C133	90863-2
Z224	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T124, C134	90864-2
Z225	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T125, C135	90865-2
Z226	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T126, C136	90866-2
Z227 thru Z230	Not used	
Z231	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T131, C151 and C161	90871-2
Z232	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T132, C152 and C162	90872-2
Z233	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T133, C153 and C163	90873-2
Z234	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T134, C154 and C164	90874-2
Z235	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T135, C155, C165 and R118	90875-2
Z236	TRANSFORMER ASSEMBLY, RADIO FREQUENCY: consists of T136, C156, C166 and R119	90876-2
Z237 thru Z299	Not used	

ACCESSORIES

SYMBOL	DESCRIPTION	STODDART NO.
E400	Not used	
E401	ANTENNA ASSEMBLY: HF; dipole head assembly with elements; 88-400 Mc; 50 ohm	91870-2
E402	ANTENNA ASSEMBLY: LF; dipole head assembly with elements; 20-88 Mc; 50 ohm	91865-2
E403	ANTENNA BASE: loop	90995-2
E404	CONNECTOR, ADAPTER: RF plug; UG-349/U	10481
E405	ANTENNA BASE ASSEMBLY: vertical optional ground plane	91972-4
E406	ANTENNA: loop; insulated	90799-2
E407	CLIP: battery	10436
E408	Same as E407	
E409	CONNECTOR: RF; UG-29B/U	10635
E410	ANTENNA ELEMENT: telescoping type	11497
E411	ANTENNA ELEMENT: telescoping type	11498
E412	ANTENNA ELEMENT: telescoping type	11503
E413	Same as E411 (one half of dipole elements of low frequency dipole antenna)	
E414	ADAPTER, CONNECTOR: adapts 3-wire plug to 2-pin ac outlet	11146
E415	ADAPTER, CONNECTOR: type "N" right angle connector	10619
E416	CLIP, ELECTRICAL: battery clip	10077
E417	Same as E416	
H401	MEASURING TAPE FREQUENCY:	10645
J400	Not used	
J401	CONNECTOR, RECEPTACLE: coaxial p/o E401 (reference only)	
J402	CONNECTOR, RECEPTACLE: coaxial p/o E402 (reference only)	
J403	Not used	
J404	CONNECTOR, RECEPTACLE: loop antenna; cable connecting end of E404; (reference only)	10696
J405	CONNECTOR, RECEPTACLE: loop antenna; BNC; E406 connector (reference only)	10481
J406	CONNECTOR, RECEPTACLE: type "N", E403 cable connector (reference only)	
J407	CONNECTOR, RECEPTACLE: type "N", one end of E409 (reference only)	
J408	CONNECTOR, RECEPTACLE: type "N", one end of E409 (reference only)	
J409	Same as J402 (reference only)	
J410	Not used	
J411	CONNECTOR, RECEPTACLE: male; 3 contacts	10042
M400	Not used	
M401	METER, MULTI-SCALE: dc; 0-1 ma	90078-11
P400	Not used	
P401	CONNECTOR, PLUG: type "N", coaxial; UG-21D/U	10701
P402	Same as P401	
P403	CONNECTOR, RECEPTACLE: female; 3 contacts	11136
P404	CONNECTOR, PLUG: male; 2-blade contacts; 1 ground conductor; molded on power cable	10944
P405	CONNECTOR, PLUG: AN type UG-536/U "N" type; straight shape	10478
P406	CONNECTOR, PLUG: male; 5 contacts	11177
P407	CONNECTOR, RECEPTACLE: female; 5 contacts	11176
P408	CONNECTOR, RECEPTACLE: end of E404 which connects to transmission line (reference only)	
P409	CONNECTOR, PLUG: coaxial	10228
P410	PLUG, TELEPHONE: 2 contacts	10089
P411	JACK, TELEPHONE: 2 contacts	10087
P412	PLUG, TELEPHONE: 3 contacts	10088
P413	CONNECTOR, RECEPTACLE: female; 3 contacts	10069
P414	CONNECTOR, RECEPTACLE: BNC (reference only)	
P415	CONNECTOR, PLUG: 5 female contacts	10097
W400	Not used	
W401	CABLE ASSEMBLY, RADIO FREQUENCY: RF transmission line	90933-1
W402	CABLE ASSEMBLY, RADIO FREQUENCY: RF probe cable	90757-2
W403	CABLE ASSEMBLY, POWER: AC power cable	90071-1
W404	CABLE ASSEMBLY, SPECIAL PURPOSE: oscilloscope cable	90071-1
W405	CABLE ASSEMBLY, SPECIAL PURPOSE: headphone extension cable	90074-1
W406	CABLE ASSEMBLY, SPECIAL PURPOSE: remote meter cable	90075-2
W407	CABLE ASSEMBLY, POWER: power cable	91487-1
W408	CABLE ASSEMBLY, POWER: battery cable	90098-2

INSTRUCTION MANUAL
FOR
MODEL 91923-2
POWER SUPPLY
Revised 1 November 1964

STODDART NO. 40099

SECTION I

GENERAL DESCRIPTION

1.1 SCOPE AND PURPOSE

This instruction book covers the 91923-2 Power Supply, which replaces both the 90783-2 and the 91226-1 Power Supplies. This instruction book is intended as a supplement to, and to be used with, the main instruction book of the RFI Meter. In the main instruction manual, all references to the earlier model power supplies should be changed to reflect the use of the 91923-2 Power Supply.

1.2 GENERAL DESCRIPTION

The 91923-2 Power Supply furnishes the following voltages at the indicated maximum currents:

+225 volts dc, at 170 milliamperes

- 105 volts dc, at 16 milliamperes

7.0 volts ac, at 6 amperes (This allows for the voltage drop caused by the resistance of the cable and wiring.)

The required input voltage to the 91923-2 Power Supply is 105 to 125 volts or 210 to 250 volts, 50 to 60, or 400 cycles, single phase. The power supply measures 7-5/8 inches high, 19-1/8 inches wide, and 10-1/4 inches deep, and weighs 35 pounds. The plastic transit case, used to protect the power supply during shipment, is 10 inches high, 22 inches wide, and 11-1/2 inches deep.

The master on-off switch for the complete equipment, (that is, the power supply and the RFI Meter itself) is mounted on the power supply. With the power cable connected to a primary source, an indicator lamp on the power supply lights when this POWER switch is turned to ON.

SECTION II

INSTALLATION

2.1 POWER SUPPLY REQUIREMENTS

The 91923-2 Power Supply may be operated from a 105 to 125 volt ac line or from a 210 to 250 volt ac line. At either range of line voltage the power drawn is 120 watts with the power supply delivering its full load. The line frequency may be 50 to 60 cycles or 400 cycles. For either voltage range, the 91258-1 ac Power Cable may be used without changing connectors.

2.1.1 Voltage Change Switch

To accomodate either voltage range, switch S302, located on the chassis of the power supply, must be set to the position corresponding to the voltage used. The in-use voltage setting of this switch is indicated by the metal reminder tag located to the right of the POWER INPUT receptacle. This metal tag covers one half of the front panel legend "115 V-230 V". Check that the exposed portion of this panel marking, the setting of the switch, and the power source voltage agree.

2.2 RECORDER POWER SUPPLY

A receptacle is provided on the front panel of the 91923-2 Power Supply for powering a 115 volt, 15 watt ac accessory such as the 91987-( ) Milliammeter Recorder. The RECORDER power receptacle provides 115 volts ac (nominal) at the power line frequency regardless of whether the line voltage (and range selector switch S302) is 230 or 115 volts ac. The power line frequency must be 60 cycles for the 91987-2 Milliammeter Recorder or 50 cycles for the 91987-3 Milliammeter Recorder.

2.2.1 Power Supply Grounding

An auxiliary GROUND binding post is provided on the 91923-2 Power Supply. This connection is used to ground the chassis

of the power supply, the chassis of the RFI Meter, and the third pin on the RECORDER OUTLET receptacle when three-pin power outlets are not available. Grounding is for the safety of personnel and does not affect RF measurements.

Connect a good ground to the GROUND binding post on the front panel of the power supply. To avoid forming a ground loop, use only one ground point and make sure the cases of all units are placed on surfaces that are insulated from ground.

Do not ground the GROUND terminal when the 91258-1 ac Power Cable (with three-pin plug) is plugged into newer, three-pin receptacles.

SECTION III

PRINCIPLES OF OPERATION

3.1 GENERAL CIRCUIT DESCRIPTION

In this circuit description, refer to figure 3-1, the block diagram of the power supply. The primary power source is applied through J302, fuses F301 and F302, and POWER switch S301 to line filter Z301. From Z301 the primary voltage goes to C302, which makes appropriate changes in the circuit according to whether the primary power is 115 volts or 230 volts (nominal). The primary voltage is then applied to T302, which isolates the power line from the output of the power supply.

One secondary of T302 feeds the primary of power transformer T301 through the voltage regulator, K301. Thus, the primary of T301 receives a voltage that will keep the output voltage of the power supply relatively constant with changes in line voltage and load. The output of the high-voltage secondary of T301 is full wave rectified by silicon rectifiers CR301, CR303, CR304, and CR305, and the ripple is removed by filter components. This output is +225 volts dc. Bias voltage is supplied by a tap on T301 secondary in conjunction with CR302, filter components, and voltage regulator V301. The bias voltage is -105 volts dc.

Regulator amplifier V302 senses any change in either the +225 volt or the -105 volt output, and feeds back appropriate changes to regulator K301, which then compensates for the change by adjusting the voltage applied to the primary of T301. A portion of the 6.3 volt ac output is supplied by a low-voltage winding on T301, which is connected in series with the filament (6.3 volt) winding of T302. Although the primary of T302 is not regulated, the primary of T301 is, and the combination of the two low-voltage windings connected in series results in a regulated 6.3 volt filament supply for the RFI Meter.

A nominal 115 volts, obtained at the primary of T302, is made available at RECORDER OUTLET receptacle J303. This voltage is unregulated.

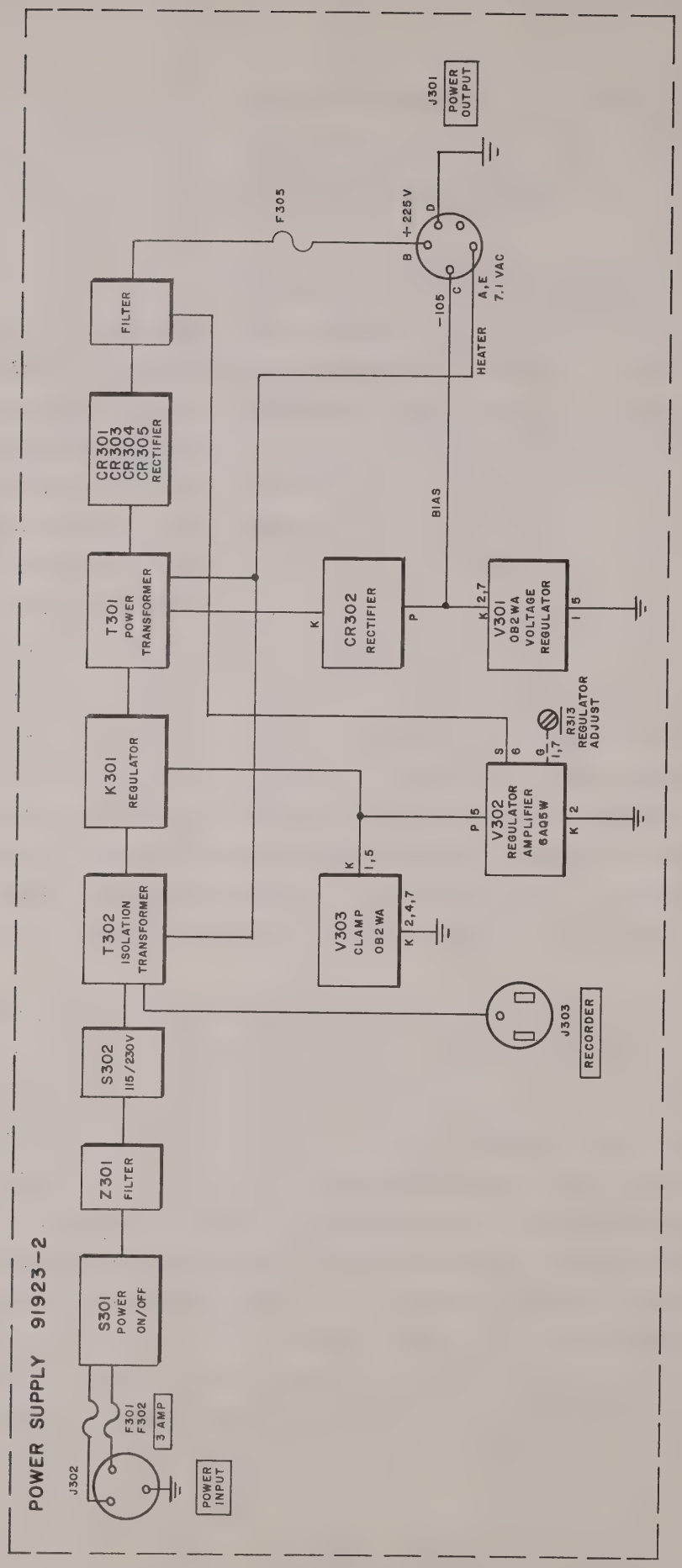


FIGURE 3-1. 91923-2 POWER SUPPLY, BLOCK DIAGRAM

A detailed circuit analysis of the power supply is given in the following paragraphs.

3.2 DETAILED CIRCUIT ANALYSIS OF POWER SUPPLY

The power supply will operate from a single phase source of 50, 60 or 400 cycles, and in either of two voltage ranges; 105 to 125, or 210 to 250 volts.

The line voltage input is fused and applied through switch S301 to line filter Z301. Filter Z301 and isolation transformer T302 prevent conducted interference from entering the RFI Meter through the power line and the power supply, and being measured as interference. They also prevent any interference that may be generated in the equipment from entering the power line. From filter Z301, the ac input is applied to a double-pole, double-throw switch S302. This switch, located on the chassis, provides for operation from a nominal 115 volt or 230 volt source by connecting the two primary windings in series when a 230 volt source is used or connecting them in parallel when a 115 volt source is used.

The input power obtained from the secondary winding (terminals 5 and 6 of T302) of the transformer is connected as follows: One side of the secondary winding of isolation transformer T302 is connected directly to one side of the primary of power transformer T301. The other side of the secondary winding of T302 is connected to the other side of T301 primary winding through a parallel resistance network consisting of R301 and an electro-mechanical voltage regulator.

The voltage regulator inserts varying values of resistance in parallel with R301 to compensate for changes in line voltage. The regulator armature position is controlled by the current through a solenoid (terminals 13 and 14 of K301). Amplification provided by V302 in the regulating relay sensing-circuit decreases the response time for improved regulation when using power line frequencies of 400 cycles. Regulator V303 is a clamp tube to prevent run-away during the warmup period of V302. After V302 has reached its operating temperature, V303 extinguishes.

The current through the solenoid is a function of the rectified output voltage. An increase in the line voltage causes an increase in the rectified output and therefore an increase in current through the solenoid. The solenoid positions the armature to insert more resistance in series with T301, primary. The increased line resistance in turn causes the rectifier output to decrease to the desired value. When the line voltage decreases, this sequence of events occurs in the opposite manner.

A high-speed averaging effect between steps is desirable to give smooth control and keep dc steps from appearing at the output as different resistors are cut in or out by the magnetic regulator. This is accomplished by sampling the pulsating output of the full-wave rectifier section (before filtering) and introducing it as a "dither" voltage to the regulator winding.

A dashpot has been incorporated to minimize "hunting". A coupling spring permits rapid, small amplitude motions in response to small signal changes.

Extensive filtering is provided against interference generated at the contacts by the use of filter chokes L301, L303, by the capacitors C301, C302, C303, C304, and the resistor R316.

The correct operating point for the system to obtain proper output voltages is established by the potentiometer R313, which sets the reference point of V302.

The output power obtained from the secondary winding (terminals 1 and 4) of T301 is full wave rectified by the four silicon rectifiers CR301, CR303, CR304, and CR305. The filter assembly L304A and the filter capacitors C305 and C306 provide a filtered output of +225 volts at pin B of J301.

The -105 volt dc bias voltage is obtained from terminals 2 and 3 of power transformer T301 and half-wave rectification through silicon rectifier CR302. This rectified voltage is filtered by C307 and L304B. Gaseous regulator tube V301 regulates the output voltage at pin C of J301 to -105 volts.

At the secondary filament winding of transformer T301, terminals 7 through 12, are wired in series with the low voltage secondary winding of transformer T302, terminals 7 through 11. These windings are so connected that the voltage of the T302 secondary, which is not regulated, is compounded by the regulated voltage output from T301. These two voltages are combined in the proper proportions by adjusting winding taps so that improved filament regulation for the RFI Meter is obtained with power input voltage change from 105 to 125 volts.

Voltage for the V302 filament and lamp I301 is taken from separate 6.3 volt taps because the filament voltage for the RFI Meter leaves the power supply at somewhat more than 6.3 volts to compensate for cable loss.

A RECORDER OUTLET receptacle J303 taps power from the filtered line supply (terminals 3 and 4 of T302) to operate a recorder which draws 15 watts or less. The voltage at this receptacle is always 115 volts irrespective of the position of S302, but the frequency is always that of the supply line. Note also that the voltage to J303 is unregulated.

SECTION IV

TROUBLESHOOTING

4.1 INTRODUCTION

The information in this section is intended to assist operating and maintenance personnel in the detection and location of malfunction in the 91923-2 Power Supply.

4.2 PREVENTIVE MAINTENANCE

The power supply is substantially moistureproof and dustproof and requires no lubrication. If normal care is taken to keep external connectors clean and avoid unusually cold, hot, or wet locations, further preventive maintenance is not required.

4.3 OVERALL TROUBLESHOOTING TECHNIQUES

The following information is given as a guide in localizing troubles in the power supply. Refer to tables 4-1 and 4-2 for procedures in addition to those given in the following paragraphs.

4.3.1 Removing the Chassis from the Case

To gain access to the parts in the power supply, rest the unit on the front panel guards. Remove four screws on the back of the case and slide the case off the chassis.

4.3.2 Preliminary Checks

Incorrect voltages to or from the power supply may give the impression of faulty operation or failure of some stage in the RFI Meter. The correct voltages at the POWER OUTPUT receptacle (J301) on the power supply, under normal load are as follows:

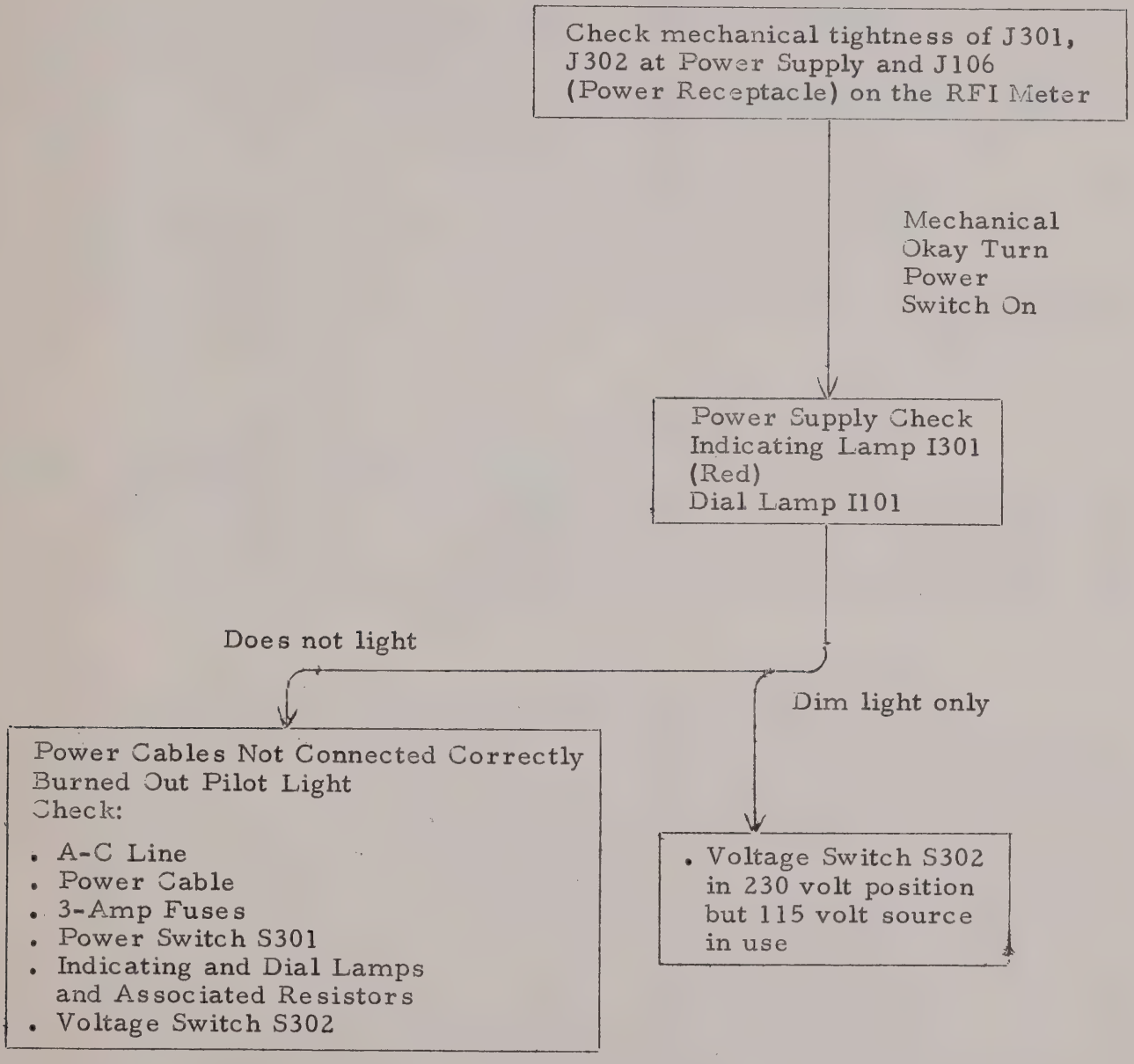
Pin A to D or E (ground) 7.1 volts ac, rms
(This allows for the voltage drop in the cable and permits 6.3 volts to be supplied to the tube filaments in the RFI Meter.)

TROUBLE-SHOOTING CHART FOR 91923-2 POWER SUPPLY

INDICATION of FAULT	INSTRUCTION	IF ABNORMAL	IF NORMAL
No output at any voltage	Check following components for continuity: fuses F301, F302; switches S301, S302; Choke Z301, R301	Replace defective component	Proceed to step 2
No output at any voltage	Check transformers T301, T302 and associated wiring for continuity	Replace defective component	Check capacitor C309 for short
No +225 vdc	Check V302 for short	Replace tube	Proceed to step 4
No +225 vdc	Check R314 and L304 for open	Replace defective component	Proceed to step 5
No +225 vdc	Check C305 and C306 for short	Replace defective component	Check wiring and plug P407
+225 vdc low plus ripple	Check diodes CR301, CR303, CR304, CR305	Replace defective diode	Check capacitor C305 for open
All output voltages low	Check input voltage	Obtain proper input voltage	Proceed to step 8
All output voltages low	If using 115 vac input, ascertain that S302 is not in 230V position	Throw switch to 115-volt position	Proceed to step 9
All output voltages low	Check setting of R313	Adjust till output voltage is correct	Check regohm (replace if faulty)
+225 vdc and 7.1 vac filament output, too high	Check tubes V302 and V303; check setting of R313	Replace defective tube	Proceed to step 11
+225 vdc and 7.1 vac filament output, too high	Check regohm	Replace faulty regohm	Check C311 for short (replace if faulty)
No -105 vdc	Check diode CR302 for open	Replace diode	Proceed to step 13
No -105 vdc	Check resistors R319 and R315 and Choke L304 for opens	Replace faulty component	Check capacitors C307 and C308 for short (replace if faulty)
-105 vdc high	Check regulator tube V301	Replace tube	
Filament voltage (pins E +A) incorrect but 225 vdc & -105 vdc correct	Change filament taps on T301 or T302		
Voltage outputs change abnormally when supply gets warm	Check resistor R311	Replace R311	Replace regohm
Voltage varies abnormally when supply first turned on	Check regulator tube V303	Replace tube	
Output voltage hunts before accomodating supply load changes	Carefully adjust dashpot adjustment on regohm		If hunting can't be stopped, replace regohm

TABLE 4-2

SIMPLIFIED TROUBLE SHOOTING CHART FOR
91923-2 POWER SUPPLY
RFI METER FULLY SET UP BUT NO POWER APPLIED


Check mechanical tightness of J301, J302 at Power Supply and J106 (Power Receptacle) on the RFI Meter
Mechanical Okay Turn Power Switch On
Power Supply Check Indicating Lamp I301 (Red) Dial Lamp I101
Does not light
Dim light only
Power Cables Not Connected Correctly
Burned Out Pilot Light
Check:
• A-C Line
• Power Cable
• 3-Amp Fuses
• Power Switch S301
• Indicating and Dial Lamps and Associated Resistors
• Voltage Switch S302
• Voltage Switch S302 in 230 volt position but 115 volt source in use

Pin B to ground	+225 volts dc
Pin C to ground	- 105 volts dc

The power supply chassis must be removed from its case (paragraph 5. 3. 1) for these voltage checks.

4. 3. 3 Localizing Troubles

Troubles in the power supply may be localized by following the procedures given in table 4-1 after first consulting table 4-2. Refer to table 4-3 for voltage measurements.

4. 4 ISOLATION OF TROUBLES

When trouble has been definitely traced to the power supply, it can be isolated to the defective part or parts by one or more of the following techniques.

4. 4. 1 Visual Inspection

A careful visual inspection will disclose certain types of faults that can cause the unit to become inoperative. Among these faults are unlit filaments, obviously burned resistors, burst or leaking electrolytic capacitors, shorted leads, and similar defects.

4. 4. 2 Tube Checks

Although the tubes should have been checked before the equipment has been declared in need of maintenance, this step may have been overlooked. Check all tubes in operative circuits,

Any of the tubes in the power supply can be replaced without seriously affecting the calibration of the RFI Meter. Be sure all tube shields are replaced before closing the unit.

4. 4. 3 Fuse Replacement

Either or both of the line fuses may be blown if the pilot lamp on the power supply does not light when the POWER switch is in the ON position. Spare fuses of the proper rating (3A, 250V, type 3AG) are

TABLE 4-3. TUBE OPERATING VOLTAGES

TUBE	TYPE AND FUNCTION	FUNC. SWITCH POSIT'N	PLATE	SCREEN	CATHODE	GRID	HEATER
V301	OB2WA -105 Reference	ANY	P1, 5		P2 0		
V302	6005/ 6AQ5 DC Amp	ANY	P5 95	P6 235	P2 0	P1, 7 P1, 7	P3-P4
V303	OB2WA -105 Limiter	ANY	P1-P5 P1-95 P5-95		P2, 4, 7 0		

All voltages measured with 20,000 ohms-per-volt multimeter.

located in the spare fuse holders on the power supply front panel. Replace fuses in the spare fuse holders as soon as possible.

CAUTION

Never replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, do not replace it again until the cause has been located and corrected.

4.4.4 Voltage Checks

Troubleshooting by checking voltages is sometimes the most efficient way of pinpointing defective parts. If the same voltage is observed at both ends of a resistor, there is obviously no current flowing through the resistor. In this case, check for the presence of proper filament, cathode, and grid voltages as well as a faulty tube or open resistor. Refer to table 4-3.

When resistors and/or chokes or transformers are in series across a voltage, the open component can be located quickly by making a point-to-point voltage check. Where a circuit is inoperative but the tube and supply voltages are known to be correct, an improper reading at a screen, plate, or cathode can indicate a shorted bypass or coupling capacitor.

4.4.5 Continuity Checks

The use of an ohmmeter to make continuity checks is particularly useful when checking leads between components or circuits. Open resistors, chokes, or transformers can be located by continuity checks as can shorted capacitors.

When a defective component is replaced, further checks should be made before turning the equipment on. In normal usage a power transformer or a plate or screen resistor will rarely burn out without some other abnormal condition such as a shorted tube or filter capacitor.

4.4.6 Troubleshooting Charts

Tables 4-1 and 4-2 may be used as a guide in tracing circuit faults. The procedures should be followed carefully but with attention given to failure possibilities which are not listed.

4.5 REPAIRS

4.5.1 Disassembly Precautions

If it is necessary to remove the front panel from the chassis (after removing the power supply from the case), first unsolder the leads from RECORDER OUTLET receptacle J303 and from input filter Z301. If this is not done there is danger of breaking the small ceramic feedthroughs on the filter.

4.5.2 Replacement of Parts

Defective parts should be replaced with correct replacement parts as listed in section 5. Upon removing the defective part, install the replacement part in the exact position of the original part. Keep the leads on the replacement part the exact length as those on the original part. Refer to table 4-3 for voltage measurements.

4.6 ADJUSTMENT OF POWER SUPPLY

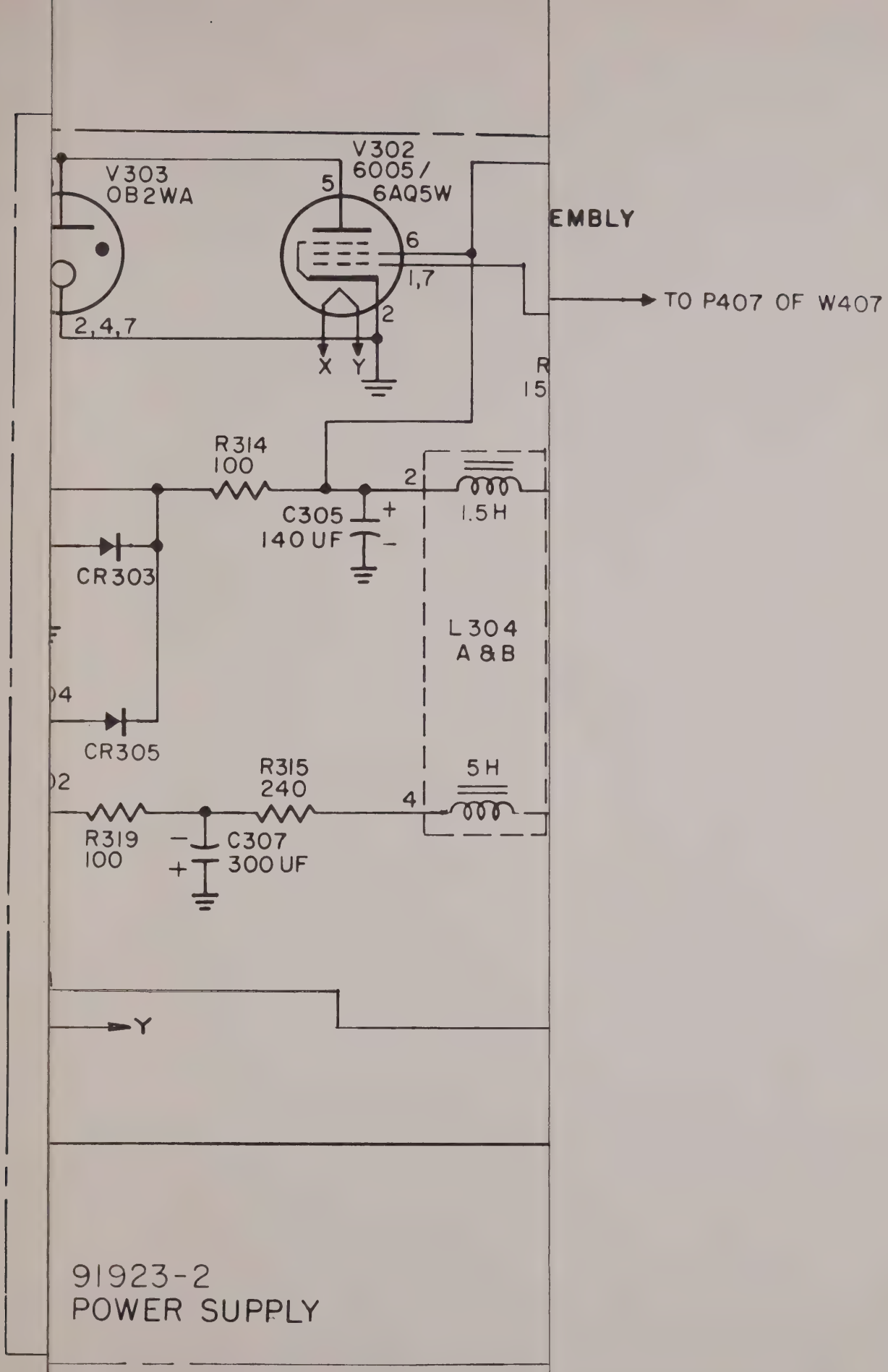
The only adjustable control is R313. Adjusting this control varies both the B + and filament voltages simultaneously. Clockwise rotation increases the voltage. The bias voltage is obtained from a gaseous regulator and cannot be adjusted. To adjust B + and filament voltages, proceed as follows:

1. With RFI Meter connected as normal power supply load, connect multimeter equivalent to Triplett 630-A between power connector pin B (B +) and ground.
2. Connect 115 volt ac power plug to a variable voltage transformer.

3. With line input adjusted to 115 volts ac, adjust R313 for +225 volts dc indication on multimeter.
4. Vary line voltage from 105 to 125 volts ac. Check that B + voltage remains at +225 volts dc.

NOTE

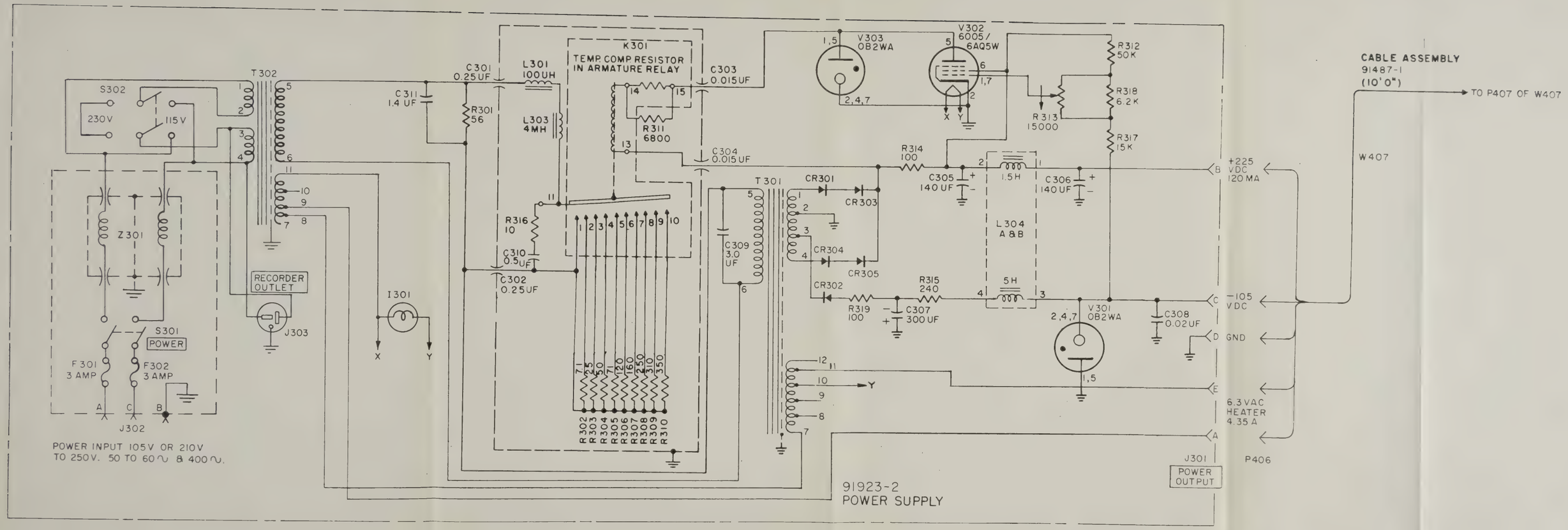
The filament supply should measure 7.1 volts ac at the power supply and 6.3 volts ac at the RFI Meter. Any filament voltage within range of 6.2 to 6.4 volts is permissible during test of step 4 above.


V303
0B2WA
V302
6005/
6AQ5W
5
6
1,7
2
2,4,7
X
Y
EMBLY
TO P407 OF W407
R
15
R314
100
2
1.5H
C305
140 UF
+
-
CR303
L304
A&B
)4
CR305
)2
R315
240
5H
4
R319
100
C307
300 UF
Y
91923-2
POWER SUPPLY

3. With line input adjusted to 115 volts ac, adjust R313 for +225 volts dc indication on multimeter.
4. Vary line voltage from 105 to 125 volts ac. Check that B + voltage remains at +225 volts dc.

NOTE

The filament supply should measure 7.1 volts ac at the power supply and 6.3 volts ac at the RFI Meter. Any filament voltage within range of 6.2 to 6.4 volts is permissible during test of step 4 above.


T302
S302
230V
115V
Z301
S301
POWER
F301
3 AMP
F302
3 AMP
J302
POWER INPUT 105V OR 210V
TO 250V. 50 TO 60∿ & 400∿.
RECORDER
OUTLET
J303
I301
X
Y
C311
1.4 UF
C301
0.25UF
L301
100UH
R301
56
L303
4MH
K301
TEMP COMP RESISTOR
IN ARMATURE RELAY
R311
6800
C303
0.015UF
C304
0.015UF
R316
10
C310
0.5UF
C302
0.25UF
R302
7.1
R303
25
R304
50
R305
71
R306
120
R307
160
R308
250
R309
310
R310
350
T301
C309
3.0
UF
V303
0B2WA
V302
6005/
6AQ5W
R312
50K
R318
6.2K
R313
15000
R317
15K
R314
100
C305
140 UF
C306
140 UF
1.5H
L304
A&B
5H
CR301
CR303
CR304
CR305
CR302
R319
100
R315
240
C307
300 UF
V301
0B2WA
C308
0.02UF
+225
VDC
120MA
−105
VDC
GND
6.3VAC
HEATER
4.35A
P406
J301
POWER
OUTPUT
CABLE ASSEMBLY
91487-1
(10'0")
TO P407 OF W407
W407
91923-2
POWER SUPPLY

SECTION V

PARTS LIST

5.1 INTRODUCTION

Reference symbols have been assigned to identify all maintenance parts of the Power Supply. They are used for marking the equipment (adjacent to the part they identify) and are included in the drawings, diagrams and the parts list. The letter of the reference designation indicates the kind of part (generic group), such as resistor or electron tube.

A socket associated with a particular plug-in device, such as an electron tube or a fuse, is identified by a reference designation that includes a number portion of the reference designation of the plug-in device. For example, the socket for electron tube V303 is designated XV303.

5.2 MAINTENANCE PARTS LIST

A tabulated list of the component parts of the Power Supply is given in this section.

POWER SUPPLY

SYMBOL	DESCRIPTION	STODDART NO.
C300	Not used	
C301	CAPACITOR, FIXED, CERAMIC: feed-thru; 250,000 pf; 1 amp; 115 vac	11162
C302	Same as C301	
C303	CAPACITOR, FIXED, PAPER: 15,000 pf; ± 20%; 400 vdcw	11168
C304	Same as C303	
C305	CAPACITOR, FIXED, ELECTROLYTIC: two-section; 70-70 µf; -10% +100%; 300 vdcw	11008
C306	Same as C305	
C307	CAPACITOR, FIXED, ELECTROLYTIC: 300 µf; 150 vdcw	10273
C308	CAPACITOR, FIXED, CERAMIC: disc type; 20,000 pf; 450 vdcw	10493
C309	CAPACITOR, FIXED, PAPER: 3.0 µf; ± 10%; 600 vdcw	11527
C310	CAPACITOR, FIXED, PAPER: 500,000 pf; 600 vdcw	10021
C311	CAPACITOR, FIXED, PAPER: 1.4 µf; ± 20%; 60 vdcw	11170
CR300	Not used	
CR301	SEMICONDUCTOR DEVICE, DIODE: 400 v; 750 ma	11718
CR302	Same as CR301	
CR303	Same as CR301	
CR304	Same as CR301	
CR305	Same as CR301	
E300	Not used	
E301	SHIELD, ELECTRON TUBE: brass nickle plated	10039
E302	Same as E301	
E303	Same as E301	
E304	COVER, ELECTRICAL CONNECTOR: aluminum, sand blasted finish	10157
E305	POST, BINDING: push type	10171
F300	Not used	
F301	FUSE, CARTRIDGE: 3 amp at 250 v	10800
F302	Same as F301	
F303	Same as F301	
F304	Same as F301	
F305	FUSE, CARTRIDGE: 3/16 amp	12196
F306	Same as F305	
I301	LAMP, INCANDESCENT: 6 to 8 v	10051
J300	Not used	
J301	CONNECTOR, RECEPTACLE: female; 5 contacts	11179
J302	CONNECTOR, RECEPTACLE: male; 3 contacts	11180
J303	CONNECTOR, RECEPTACLE: female; 3 contacts	11505
K301	RELAY: electro-mechanical type regulator	11165
L300	Not used	
L301	CHOKE, RADIO FREQUENCY: 100 µh	90292-1
L302	Not used	
L303	CHOKE, RADIO FREQUENCY: 4 mh; 1 amp current rating	11188
L304	CHOKE, FILTER: dual type; hermetically sealed	11280
R300	Not used	
R301	RESISTOR, FIXED, WIREWOUND: 56 ohms; 25 w	11173
R302	RESISTOR, FIXED, WIREWOUND: 7.1 ohms; 11 w	11157-7R1
R303	RESISTOR, FIXED, WIREWOUND: 25 ohms; 11 w	11157-250
R304	RESISTOR, FIXED, WIREWOUND: 50 ohms; 11 w	11157-500
R305	RESISTOR, FIXED, WIREWOUND: 71 ohms; 11 w	11157-710
R306	RESISTOR, FIXED, WIREWOUND: 120 ohms; 11 w	11157-121
R307	RESISTOR, FIXED, WIREWOUND: 160 ohms; 11 w	11157-161
R308	RESISTOR, FIXED, WIREWOUND: 250 ohms; 11 w	11157-251
R309	RESISTOR, FIXED, WIREWOUND: 310 ohms; 11 w	11157-311
R310	RESISTOR, FIXED, WIREWOUND: 350 ohms; 11 w	11157-351
R311	RESISTOR, FIXED, WIREWOUND: 6800 ohms; ± 5%; 3 w	11166-682
R312	RESISTOR, FIXED, WIREWOUND: 50,000 ohms; ± 5%; 10 w	11163
R313	RESISTOR, VARIABLE, WIREWOUND: 15,000 ohms; ± 5%; 3 w	11171
R314	RESISTOR, FIXED, WIREWOUND: 100 ohms; ± 5%; 25 w	10705-101
R315	RESISTOR, FIXED, COMPOSITION: 240 ohms; ± 5%; 2 w	10377-241
R316	RESISTOR, FIXED, COMPOSITION: 10 ohms; ± 5%; 1/2 w	10011-100
R317	RESISTOR, FIXED, WIREWOUND: 15,000 ohms; ± 5%; 5 w	11361-153
R318	RESISTOR, FIXED, COMPOSITION: 6200 ohms; ± 5%; 1 w	10012-622
R319	RESISTOR, FIXED, COMPOSITION: 100 ohms; ± 5%; 1 w	10012-101
S301	SWITCH, TOGGLE: DPDT	10172
S302	Same as S301	
T300	Not used	
T301	TRANSFORMER, POWER: hermetically sealed	11279
T302	TRANSFORMER, ISOLATION: for 115 or 230 volts; 50 to 400 cps	11278
V300	Not used	
V301	ELECTRON TUBE: type OB2WA	OB2WA
V302	ELECTRON TUBE: type 6005/6AQ5W	6005/6AQ5W
V303	Same as V301	
XF301	FUSE HOLDER: extractor post type	11161
XF302	Same as XF301	
XF303	Same as XF301	
XF304	Same as XF301	
XF305	Same as XF301	
XF306	Same as XF301	
XI301	LIGHT INDICATOR: with lens	10115
XK301	SOCKET, RELAY: phenolic board	11164
XV301	SOCKET, ELECTRON TUBE: JAN type; TS102P01	10118
XV302	Same as XV301	
XV303	Same as XV301	
Z300	Not used	
Z301	FILTER ASSEMBLY: power supply input	90386-1

RADIATION HAZARDS

IN RADIO INTERFERENCE MEASUREMENT

1. Biological damage from exposure to intense RF radiation has been known for several years but only recently have quantitative limits been established.

2. A tri-service limit for exposure to RF radiation has been established at .01 watts/cm^2 at any frequency. This is 194 volts/meter assuming linearly polarized plane waves. General Electric has proposed that a maximum safe limit of .001 watts/cm^2 (61 volts/meter) be used for continuous exposure and that .01 watts/cm^2 be an absolute maximum not to be exceeded except under emergency conditions.

3. It is possible that personnel operating Stoddart equipment will be exposed to power densities greater than .01 watts/cm^2. This will probably occur in locations where the rf field will not be linearly polarized plane waves such as the Fresnel Zone and in close proximity to magnetrons and klystrons.

4. It is suggested that before taking measurements near suspected or known strong radiation sources that reliable information on intensity be obtained.

Direct measurements of strong signal sources can be made with RI-FI equipment if the frequency is in the tuning range. Most RI-FI equipment does not have sufficient voltage range or shielding effectiveness to accurately measure to 194 volts/meter using standard antennas. In some situations, involving concentrated fields, the use of loop probes with their large antenna factors would enable approximate measurement. Limitations in RI-FI equipment shielding sometimes permits full scale meter indication when tuned to a very strong signal even with the antenna disconnected. Needless to say, the operator should be concerned when this occurs.

The following chart provides approximate equipment range limits (full scale) in volts/meter with and without pickup devices.

The equipment would be standardized for gain in accordance with instructions on the charts supplied. Then the input attenuator should be placed in the maximum position. Continuous wave signals would be measured in FI function switch position. Pulsed signals are measured with PEAK function.

STODDART NO. 40019-A

Equipment	Antenna	Approximate field strength volts/meter Equivalent radiation levels given in table below
NM-10A	Half meter rod	2
	30" loop (90117-2)	10
(14 kc to 250 kc)	6" loop (90114-2)	100
	Loop probe (90185-1)	1000*
	No antenna (or cable)	100 to 200
NM-20B	41" rod (90291-2)	2
	Loop antenna (90298-2)	.1
(150 kc to 25 mc)	Loop probe (90185-2)	10*
	No antenna (or cable)	20
NM-30A	Tuned dipole	1 to 50
	Loop antenna (90799-2)	170 to 500*
(20 mc to 400 mc)	No antenna (or cable)	10 to 500
NM-50	Tuned dipole	30 to 180
(375 mc to 1000 mc)	No antenna (or cable)	100 to 180

Field Strength volts/meter	Radiation Level watts/cm^2
0.1	0.265×10^{-8}
2.0	1.06×10^{-6}
10.	0.265×10^{-4}
20	1.06×10^{-4}
30	2.39×10^{-4}
50	6.63×10^{-4}
100	0.265×10^{-2}
170	0.766×10^{-2}
180	0.86×10^{-2}
200	1.06×10^{-2}
500	6.63×10^{-2}
1000	0.265

$$P = \frac{(E)^2}{120\pi} = .00265(E) \frac{2 \text{ watts}}{(\text{meter})^2}$$

P = Radiation Level

E = Field Strength - $\frac{\text{volts}}{\text{meter}}$

$$P \frac{(\text{watts})}{cm^2} = 10^{-4} \times P \frac{(\text{watts})}{(\text{meter})^2}$$

* Maximum measurement shown using loop probe antenna is only practical if RI-FI equipment is not exposed to strong RF field.

ENGINEERING DEPT.
August 27, 1959

STODDART AIRCRAFT RADIO CO., INC.
6644 Santa Monica Boulevard
Hollywood 38, California

STODDART NO. 40019-A

Warranty

Stoddart Electro Systems warrants each RFI Meter manufactured by them to be free from defects in workmanship and material. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Klystron tubes, electron tubes, fuses and batteries are specifically excluded from any liability.

This warranty is effective for one year after delivery to the original purchaser. If the fault has been caused by misuse or mishandling, repairs will be billed to the purchaser. In this case, an estimate will be submitted before the work is begun.

In the event that any defect occurs, Stoddart Electro Systems should be advised of all details and the model and serial number of the equipment. Shipping instructions and service data will be provided. To ensure safe handling, all equipment should be forwarded with protective covers in place and in strong exterior containers surrounded by several inches of rubberized hair or similar shock-absorbing material to the factory or authorized repair station via scheduled Air Freight.

CLAIM FOR DAMAGE IN TRANSIT

Equipment should be tested as soon as it is received. If it fails to operate properly, or is damaged in any manner, a claim should be filed with the transportation company. A report of the damage should be obtained by the claim agent, and this report forwarded to Stoddart Electro Systems with model and serial number of the equipment. Advice regarding repair or replacement will be supplied immediately upon receipt of this information

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